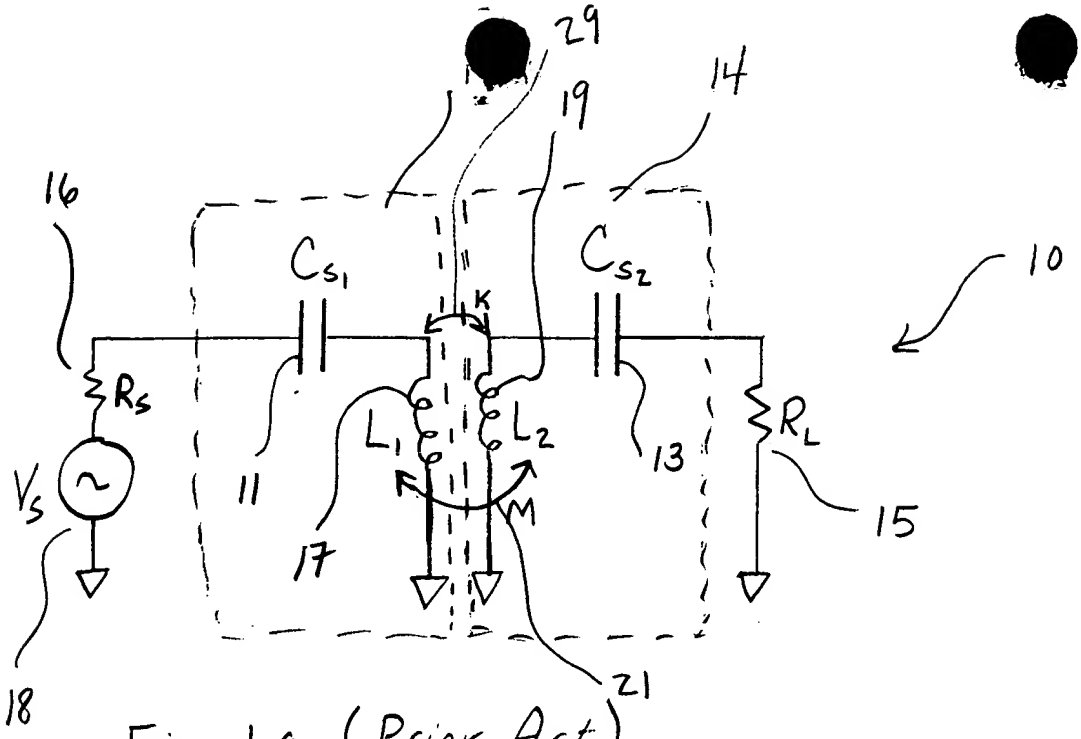


Fig. 1a (Prior Art)

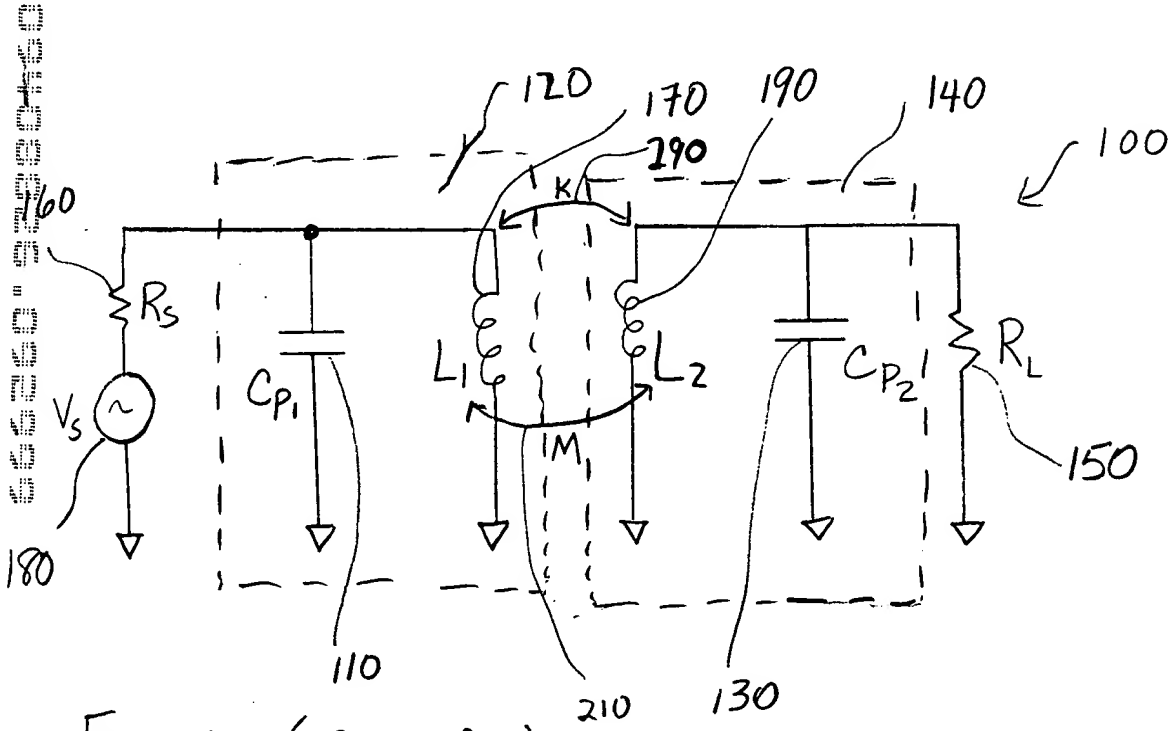


Fig. 1b (Prior Art)

58 Figs.

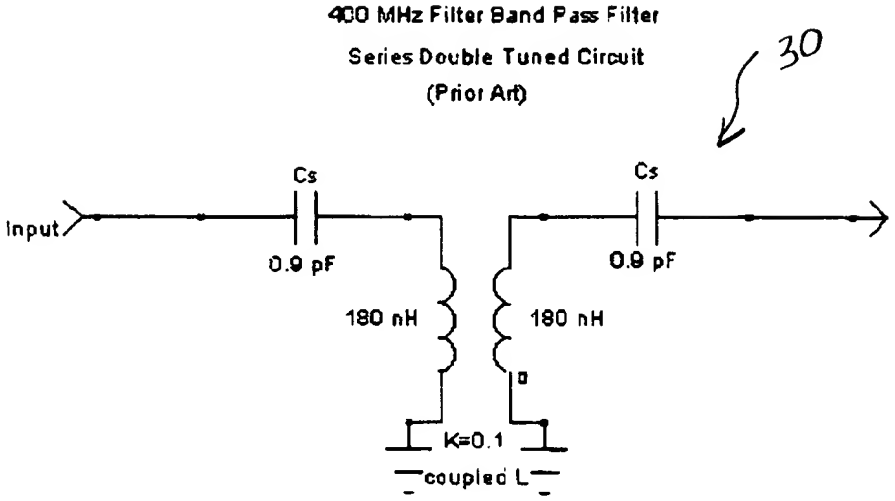
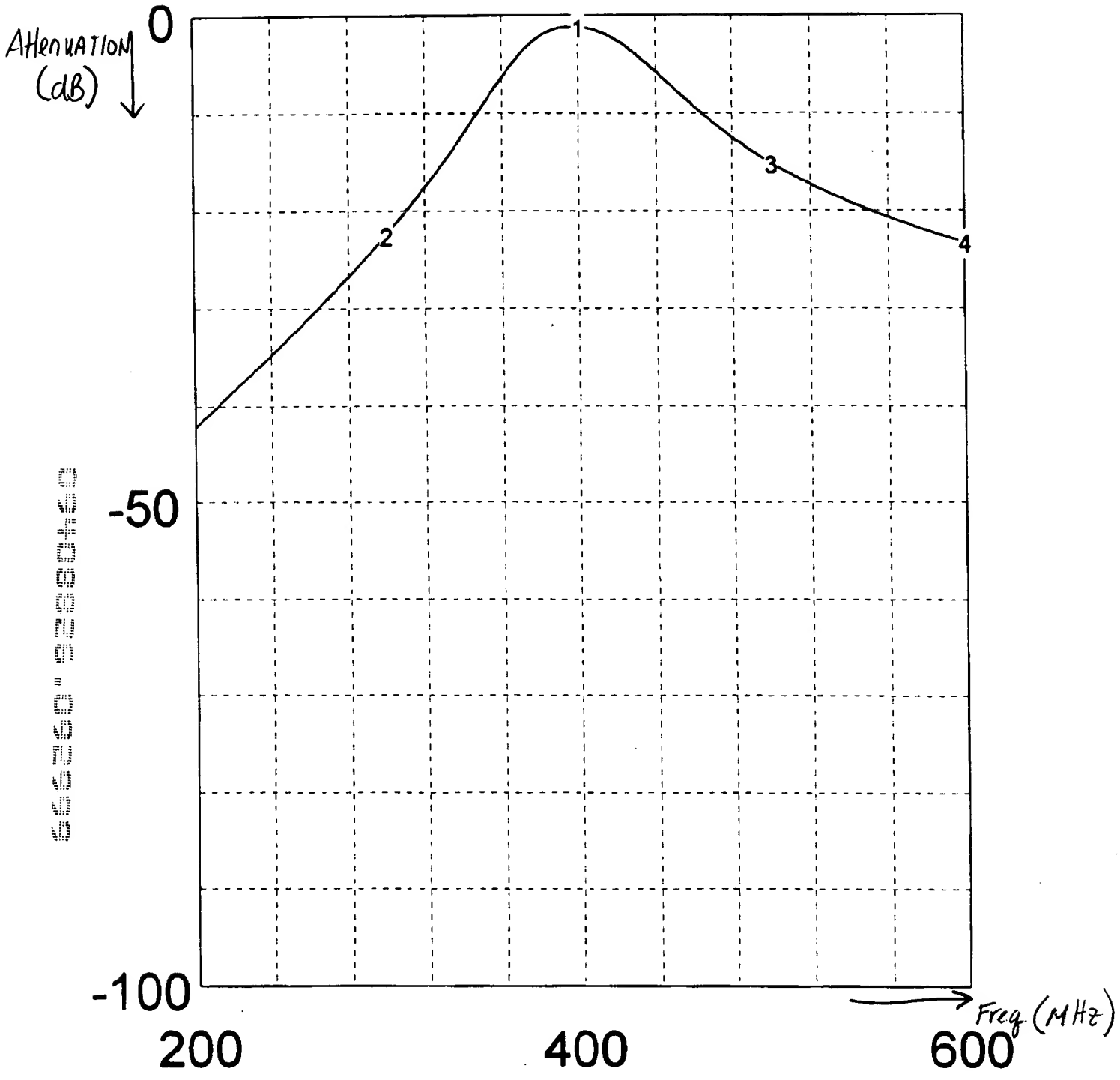
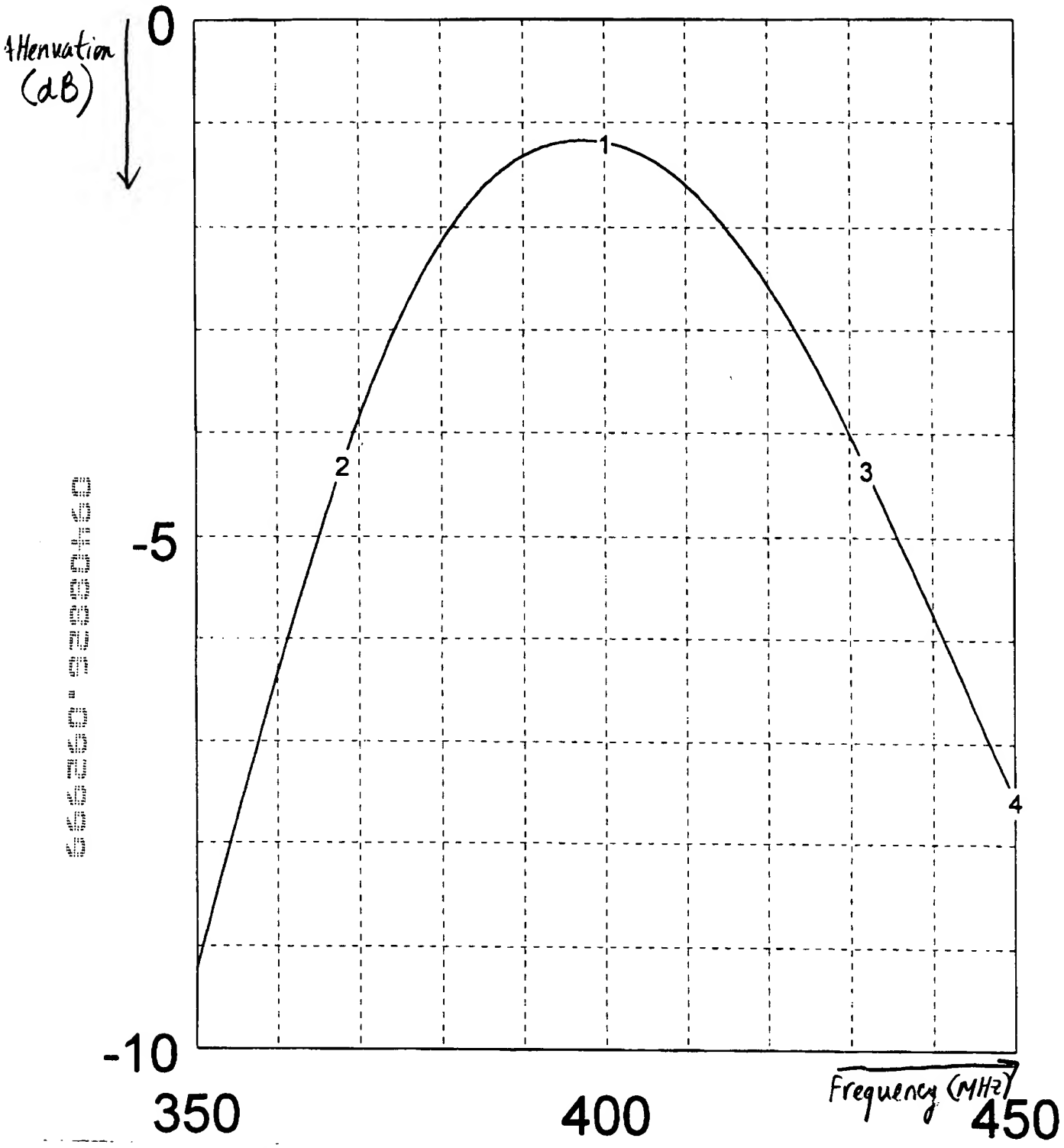


Fig. 3 (Prior Art)



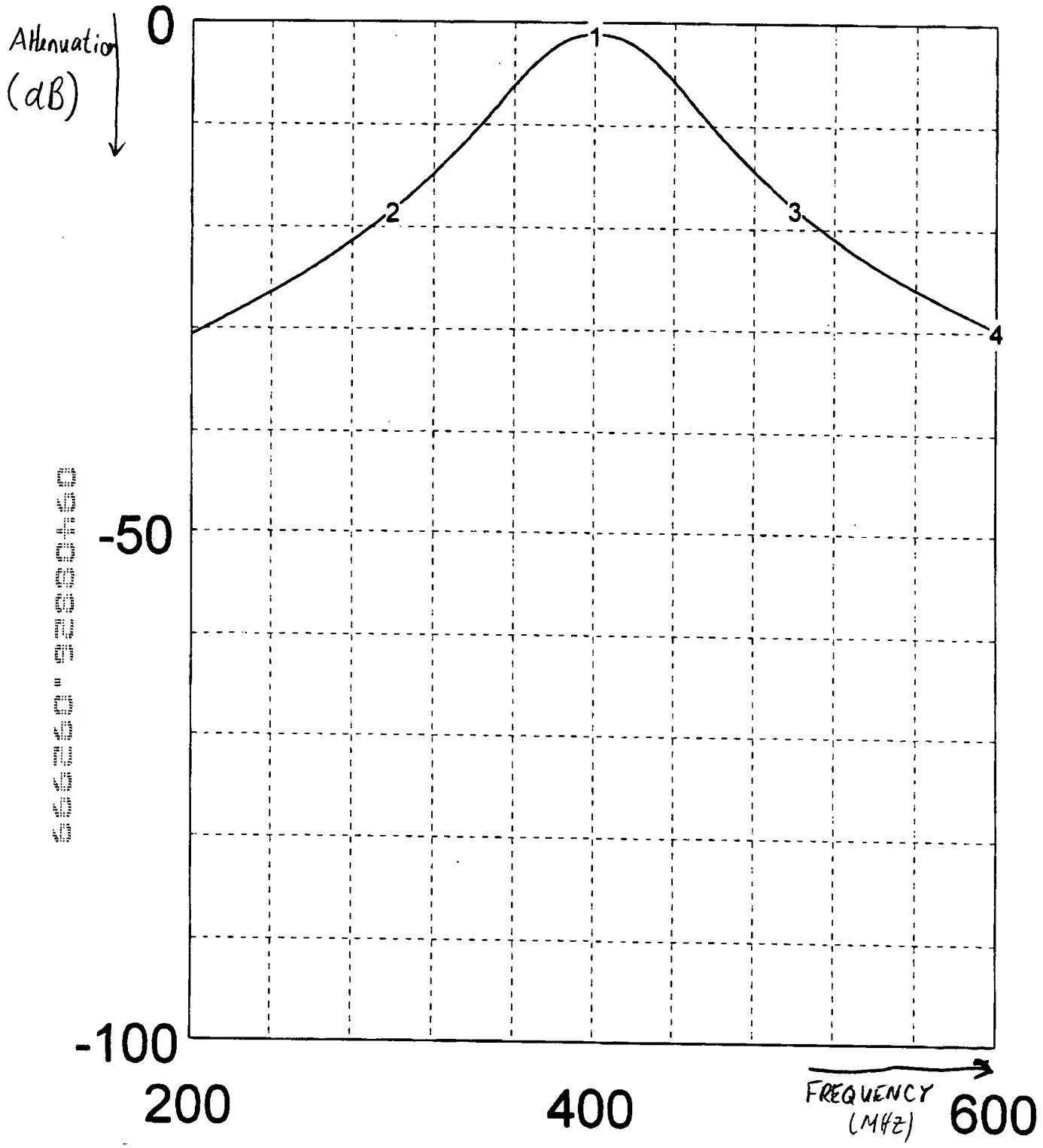
1 { 400 / -1.19704 2 { 300 / -22.4326 3 { 500 / -15.0734 4 { 600 / -23.2958

Fig. 4a (Prior Art)



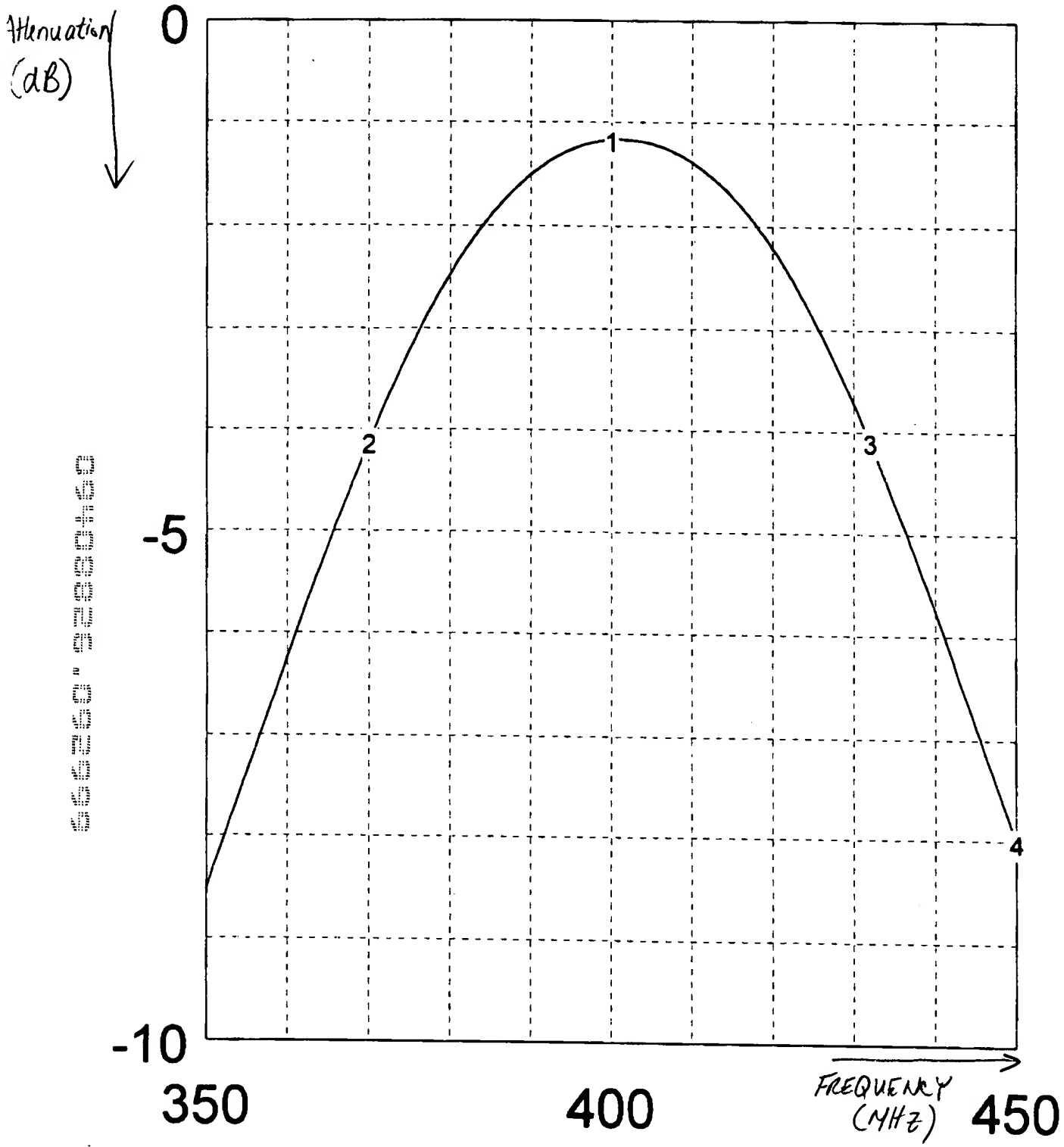
1 {400 -1.19704 2 {368 -4.31096 3 {432 -4.34352 4 {450 -7.56287

Fig. 4b (Prior Art



1 {400 -1.16808 2 {300 -18.3617 3 {500 -17.9297 4 {600 -29.7704

FIG 6a (Prior Art)



1{400 -1.16808 2{370 -4.13039 3{432 -4.09188 4{450 -8.01465

Fig. 6b (Prior Art)

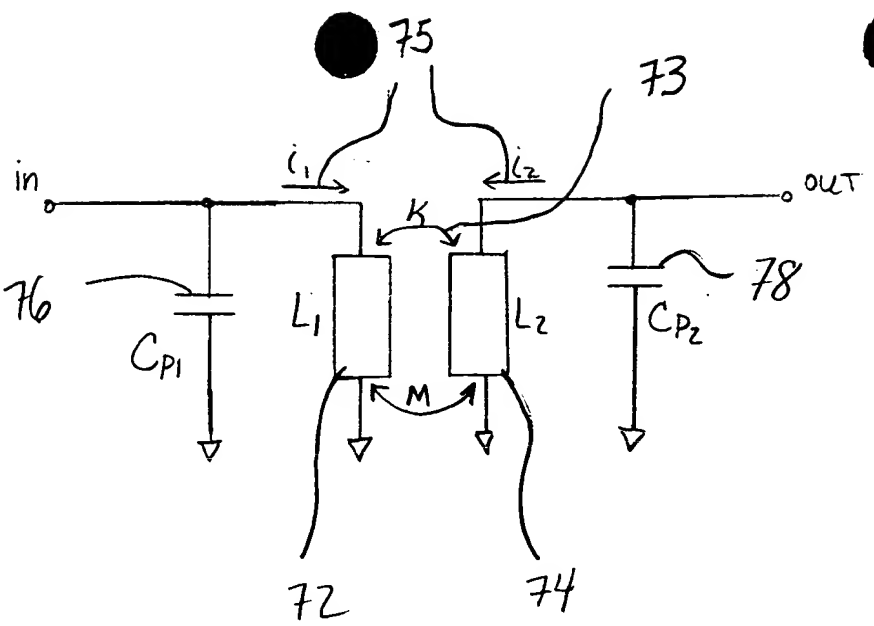


Fig. 7

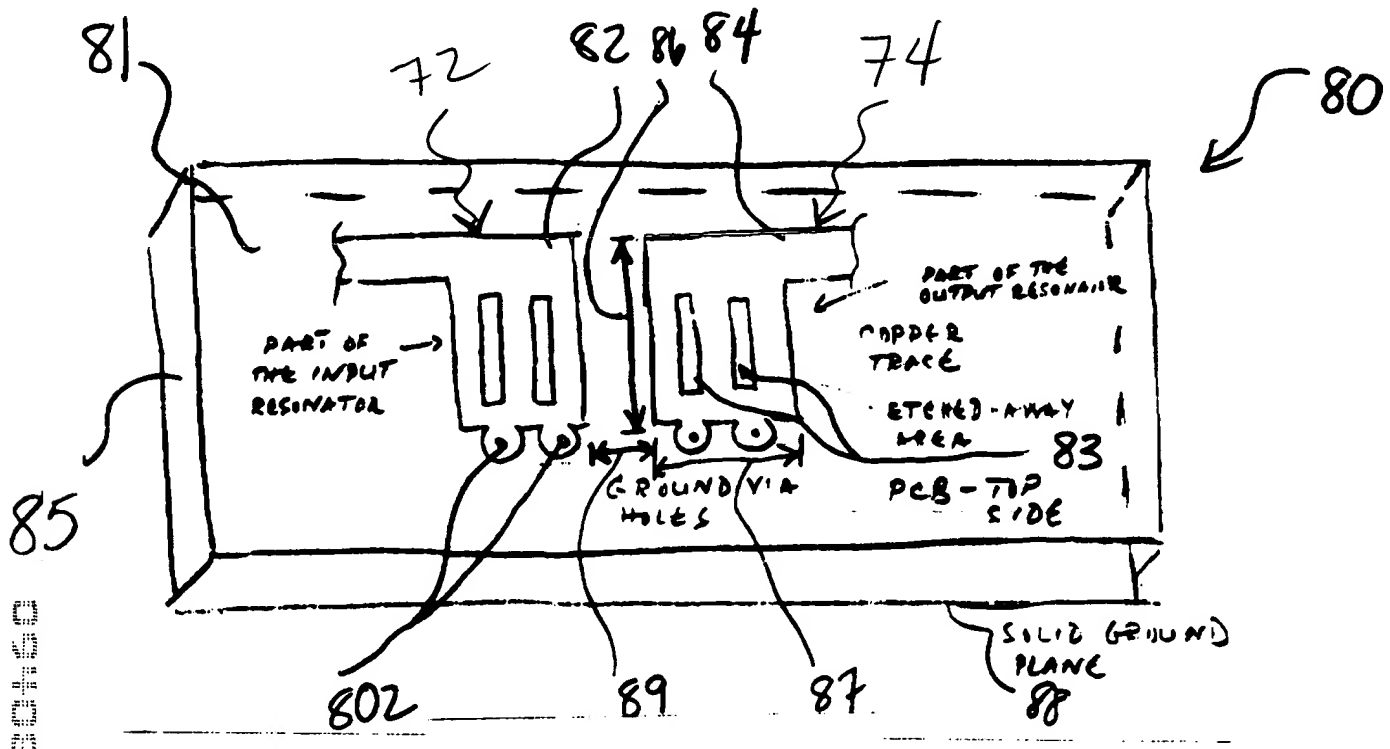

81
72
82
86
84
74
80
PART OF THE INPUT RESONATOR
PART OF THE OUTPUT RESONATOR
COPPER TRACE
ETCHED-AWAY AREA
83
GROUND VIA HOLES
PCB - TOP SIDE
85
802
89
87
SOLID GROUND PLANE
88

Fig. 8a

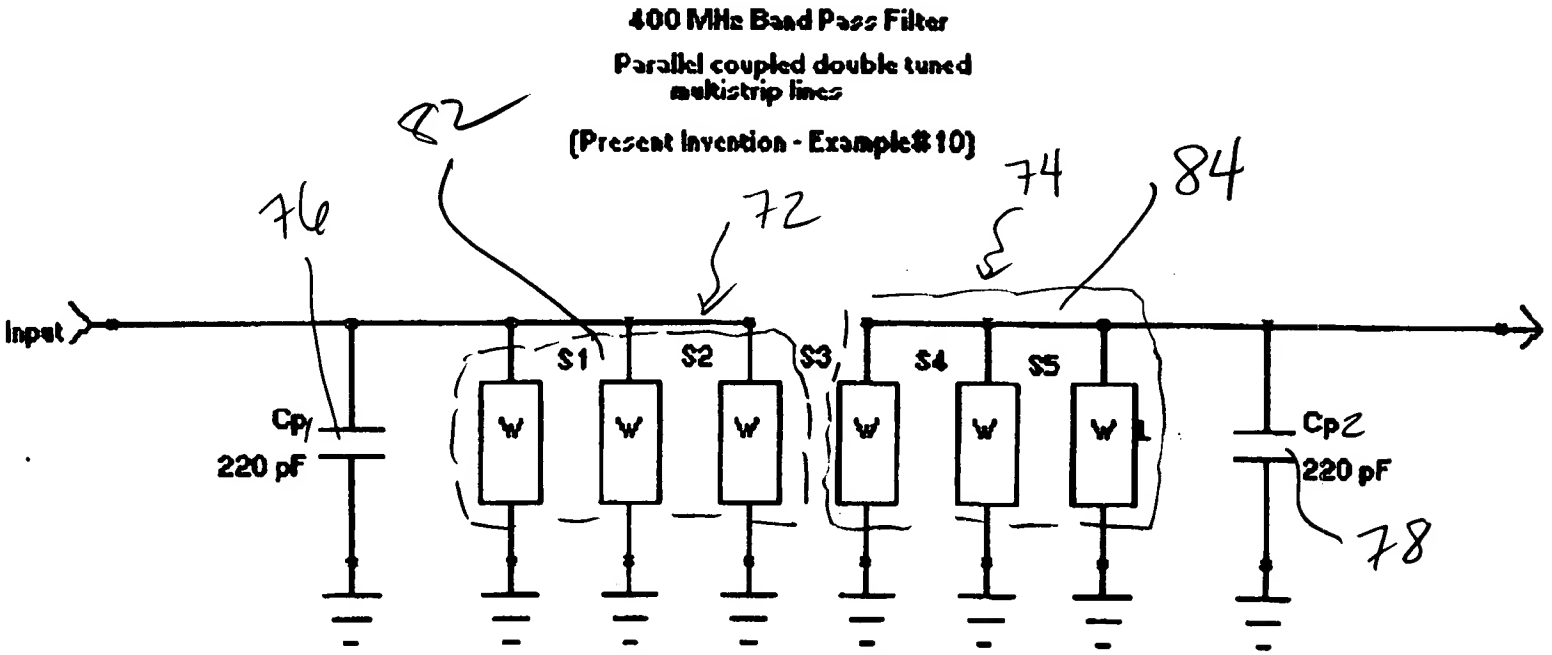
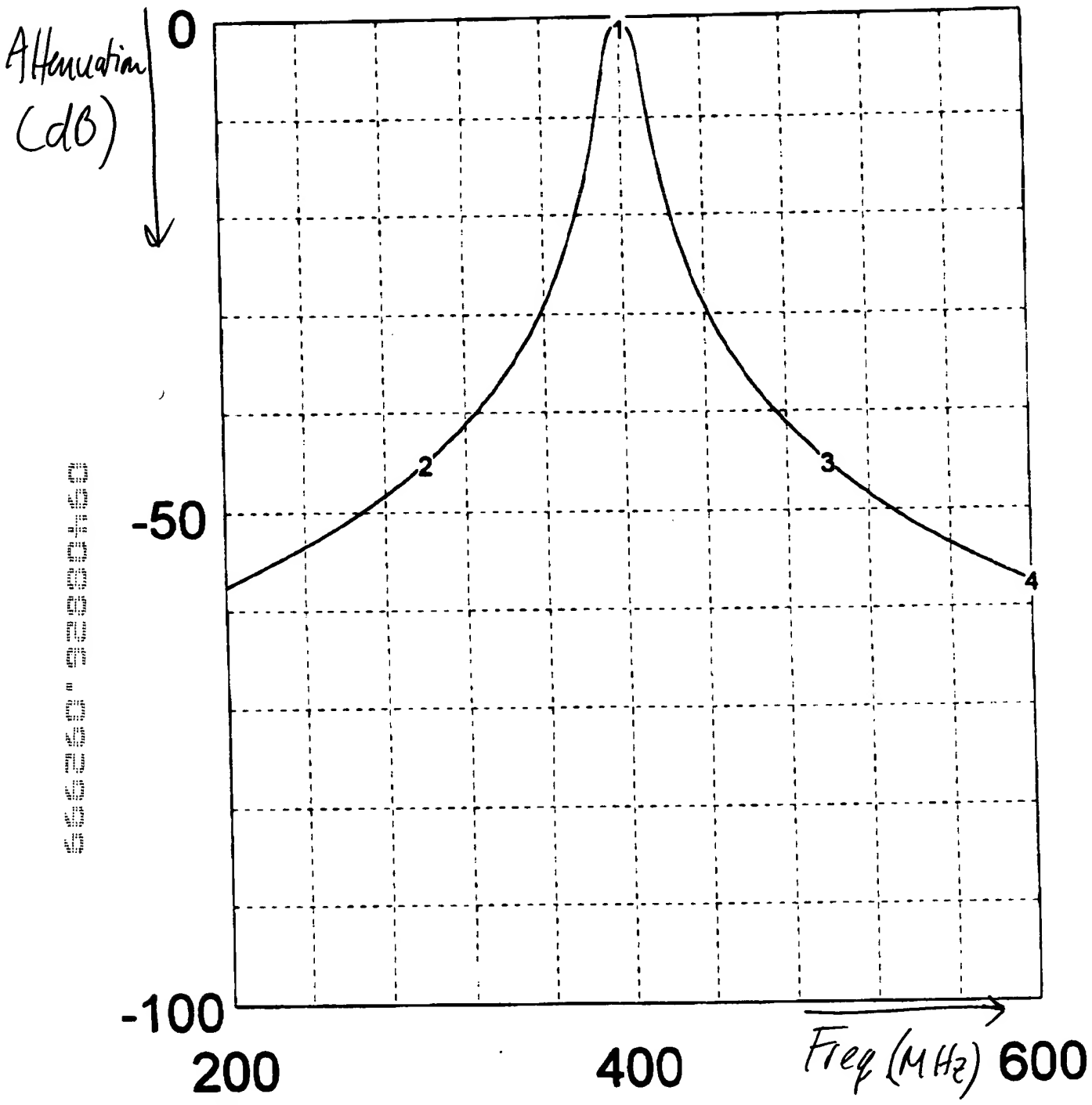

400 MHz Band Pass Filter
Parallel coupled double tuned multistrip lines
(Present invention - Example#10)
82
76
72
74
84
Input
S1
S2
S3
S4
S5
W
L
Cp1
220 pF
Cp2
220 pF
78
Multistrip_coupled microstrip line(2 resonators, 3 lines each)
Width W=2 mm, Length L=5.5 mm
Gaps:S1=S2=S4=S5=3.45 mm
S3 = 3 mm
Dielectric: er=4.65, tand=0.001
Board thickness (hight) H=1.5mm

Fig. 8b

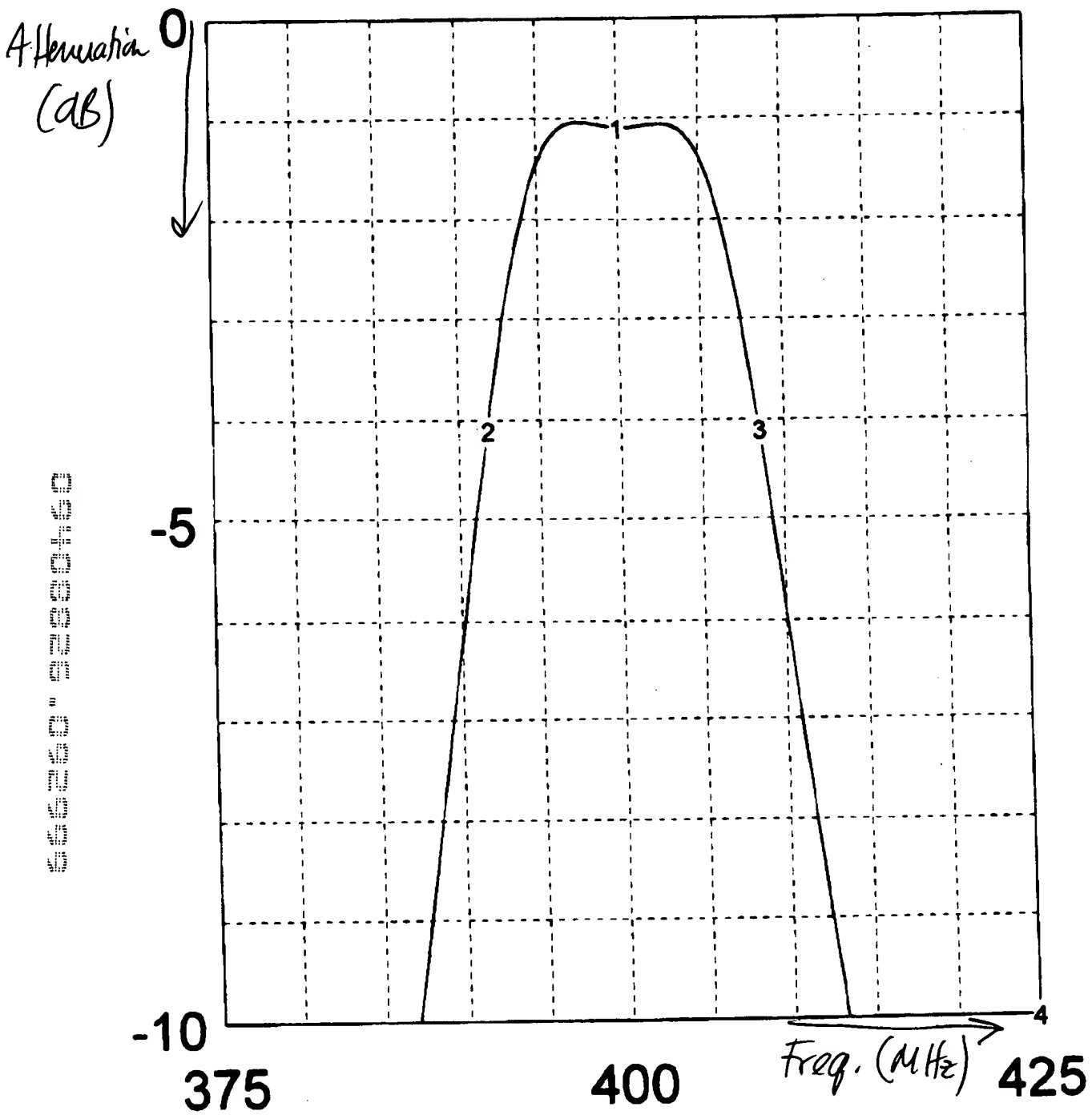
Eagleware Mar 16 09:53:51 1998 DTMLT400.SCH AMPLITUDE_10DB



400	300	500	600
-1.09187	-45.092	-45.1217	-57.4546

Fig. 9a

Eagleware Mar 16 09:53:57 1998 DTMLT400.SCH AMPLITUDE_1DB



400	391.75	408.5	425
-1.09187	-4.09212	-4.08623	-20.7976

Fig. 96

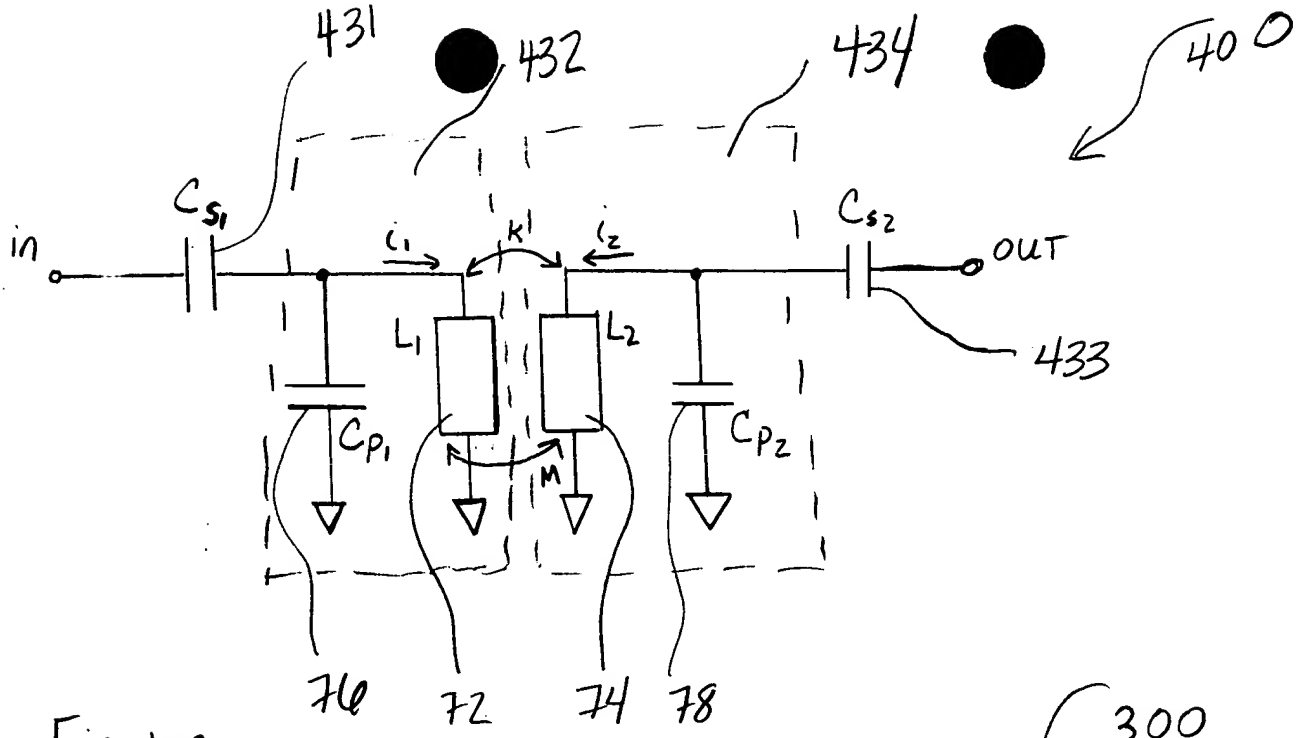


Fig. 10a

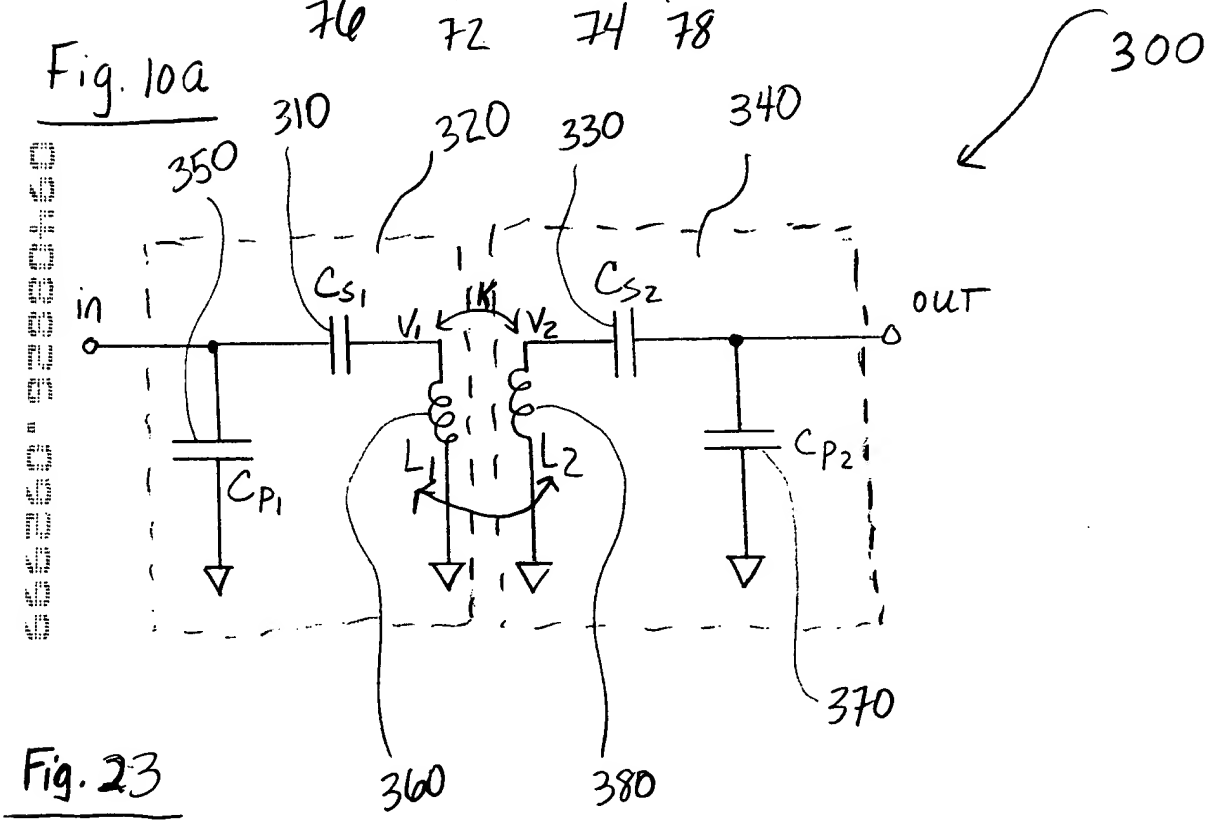
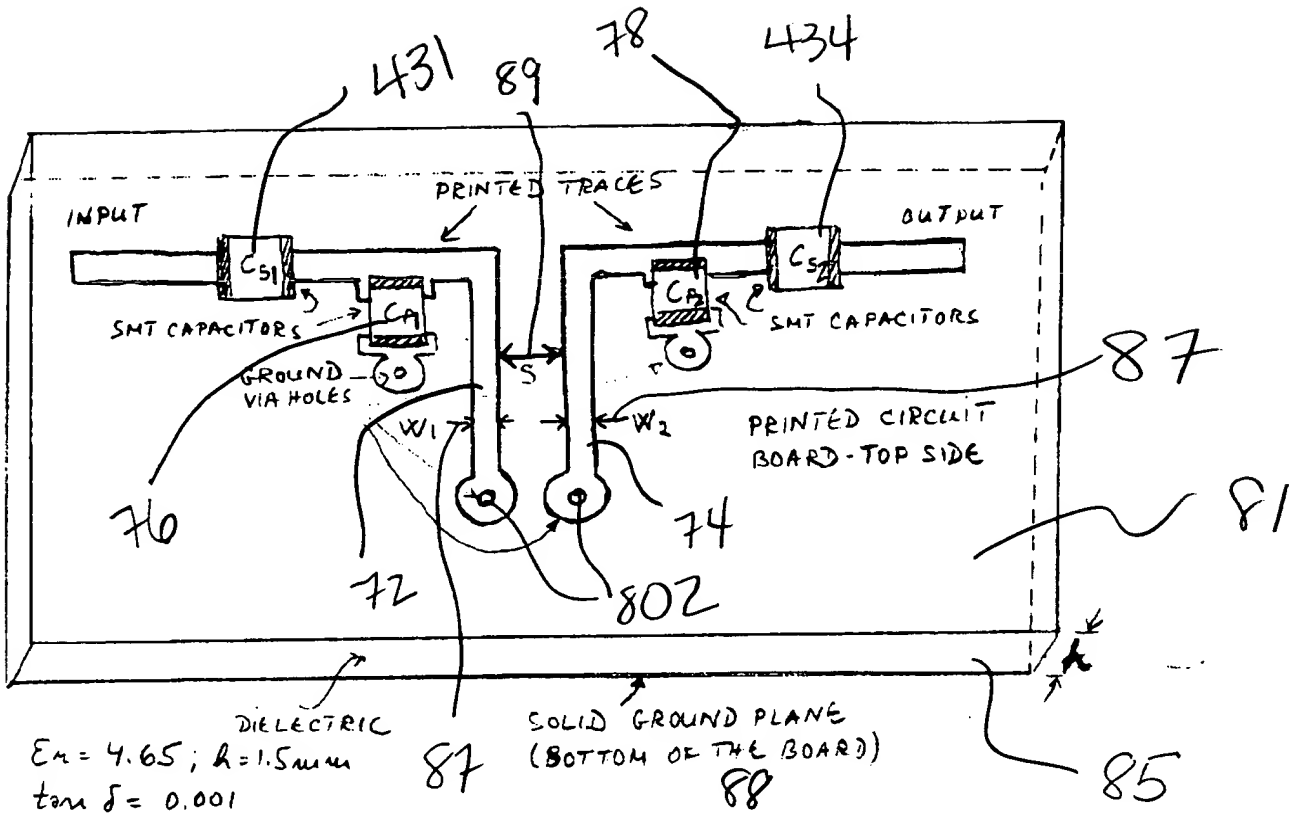


Fig. 23



(ONE EMBODIMENT)

FIGURE ___ : CONSTRUCTION OF THE COUPLED PARALLEL RESONATORS IN THE PRESENT INVENTION

Fig. 10b

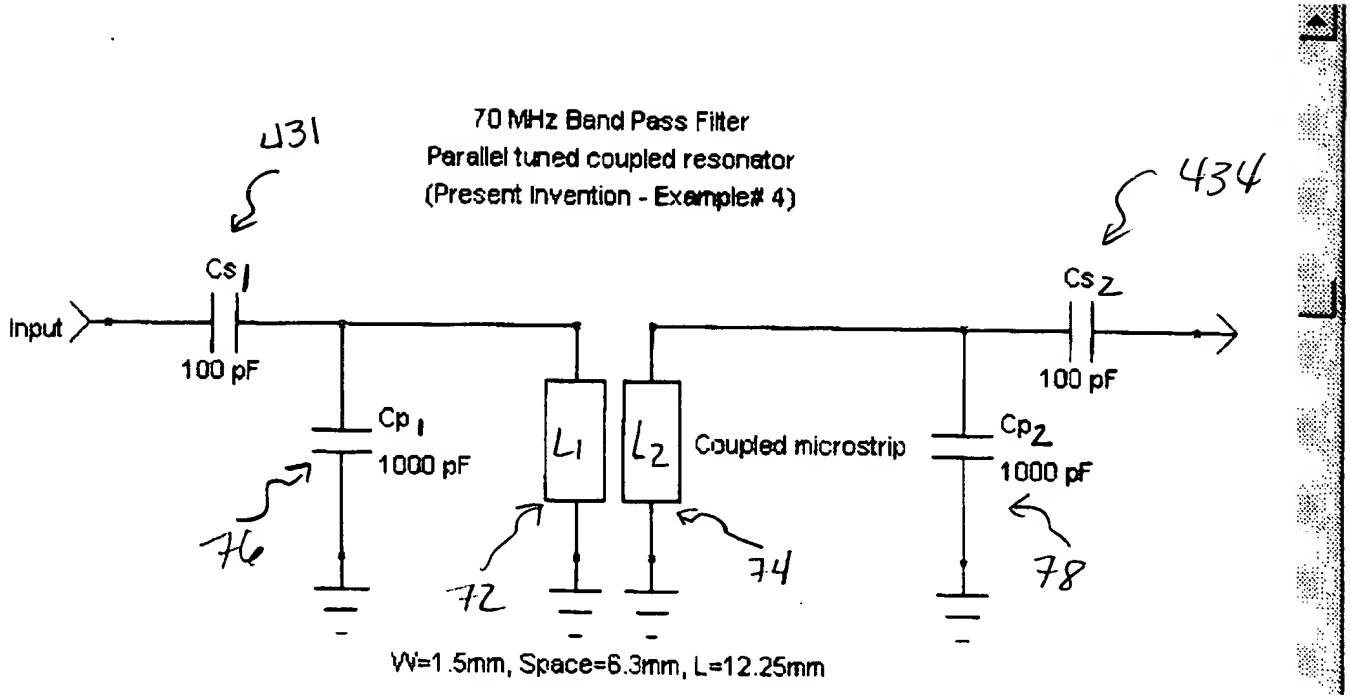
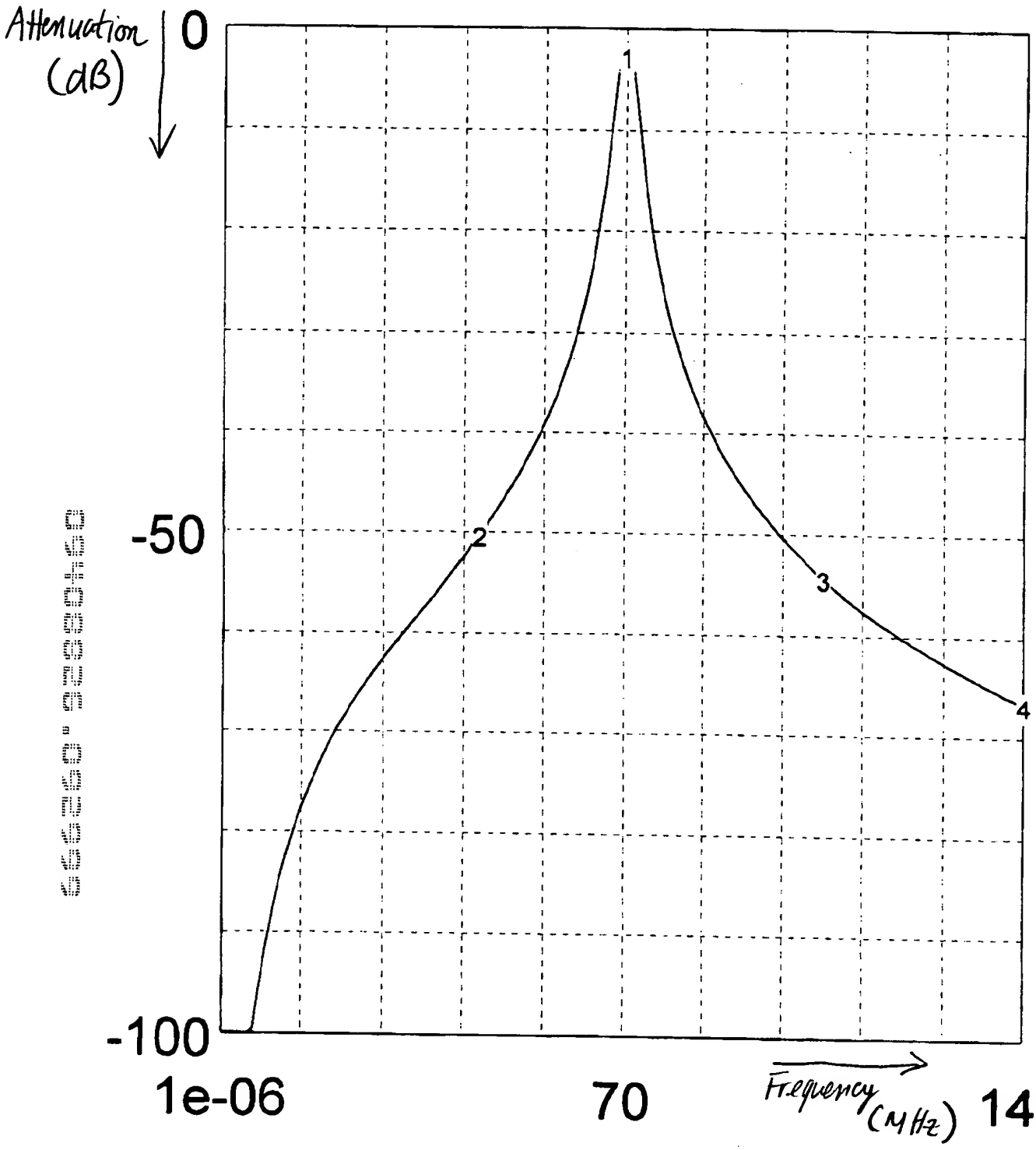

70 MHz Band Pass Filter
Parallel tuned coupled resonator
(Present Invention - Example# 4)
431
434
Cs1
Cs2
Input
100 pF
100 pF
Cp1
1000 pF
Cp2
1000 pF
L1
L2
Coupled microstrip
76
72
74
78
W=1.5mm, Space=6.3mm, L=12.25mm

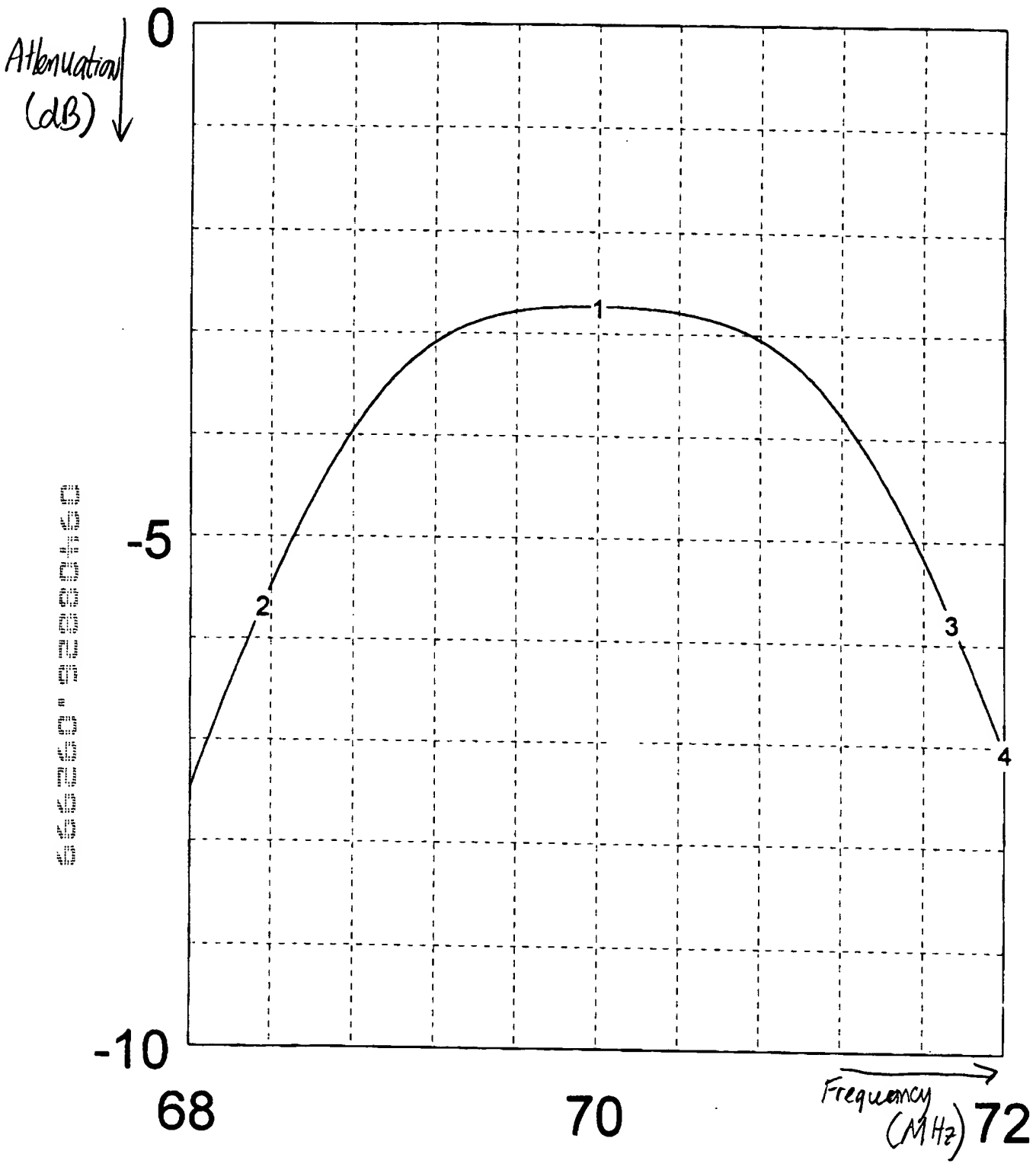
Fig. 11



70	44.8	105	140
-2.7315	-50.2972	-54.2752	-66.7522

Fig. 12a

Eagleware Mar 12 18:04:24 1998 PAR70M.SCH AMPLITUDE_1DB



70	68.36	71.74	72
-2.7315	-5.67056	-5.77978	-7.05591

Fig. 12b

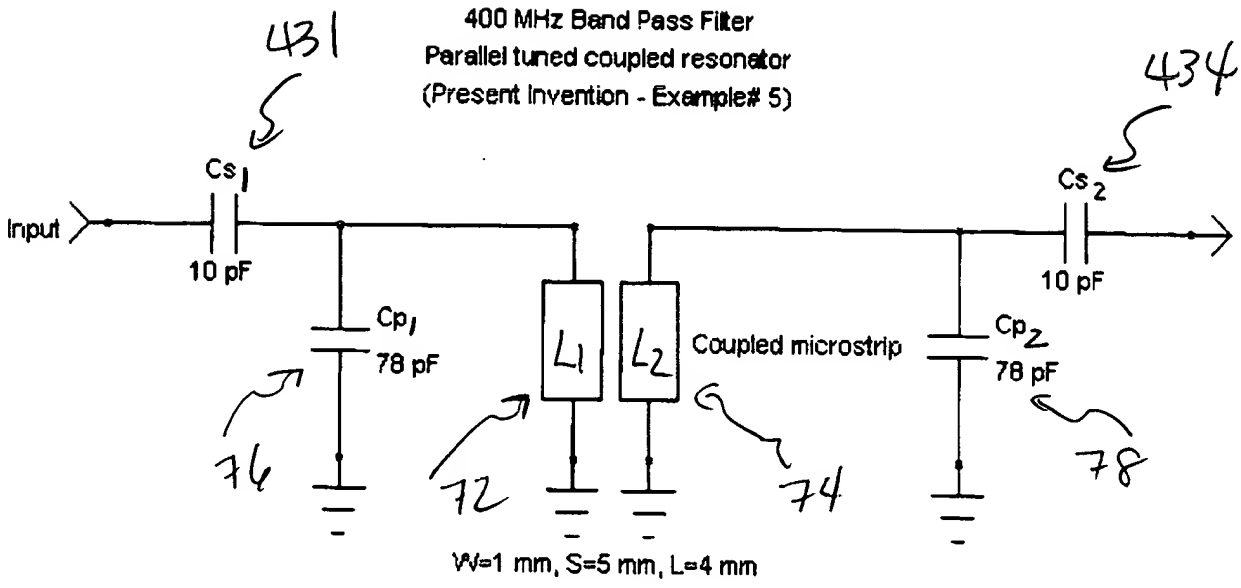
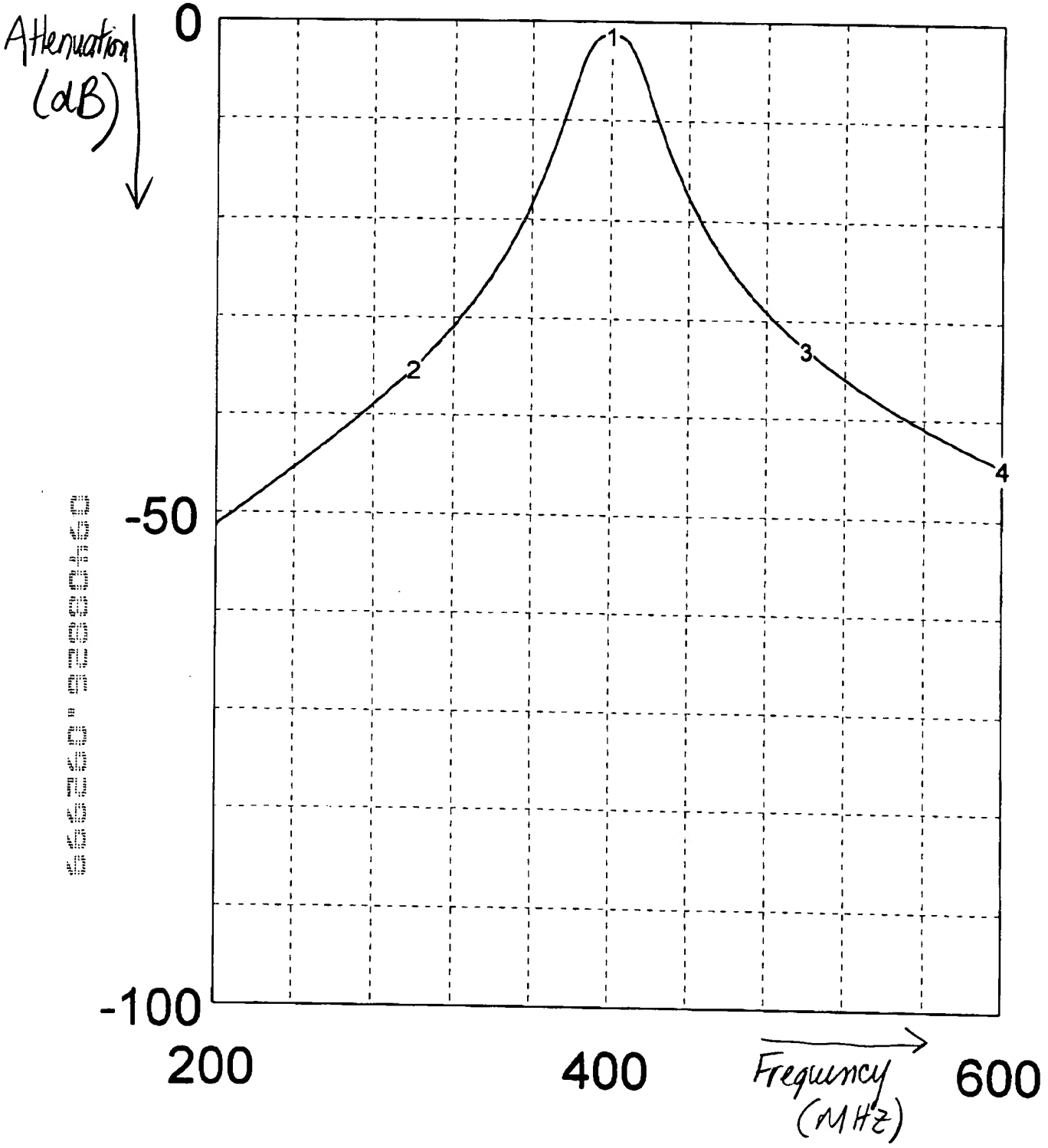

400 MHz Band Pass Filter
Parallel tuned coupled resonator
(Present Invention - Example# 5)
431
434
Cs1
Cs2
Input
10 pF
10 pF
Cp1
78 pF
Cp2
78 pF
L1
L2
Coupled microstrip
76
72
74
78
W=1 mm, S=5 mm, L=4 mm

Fig. 13

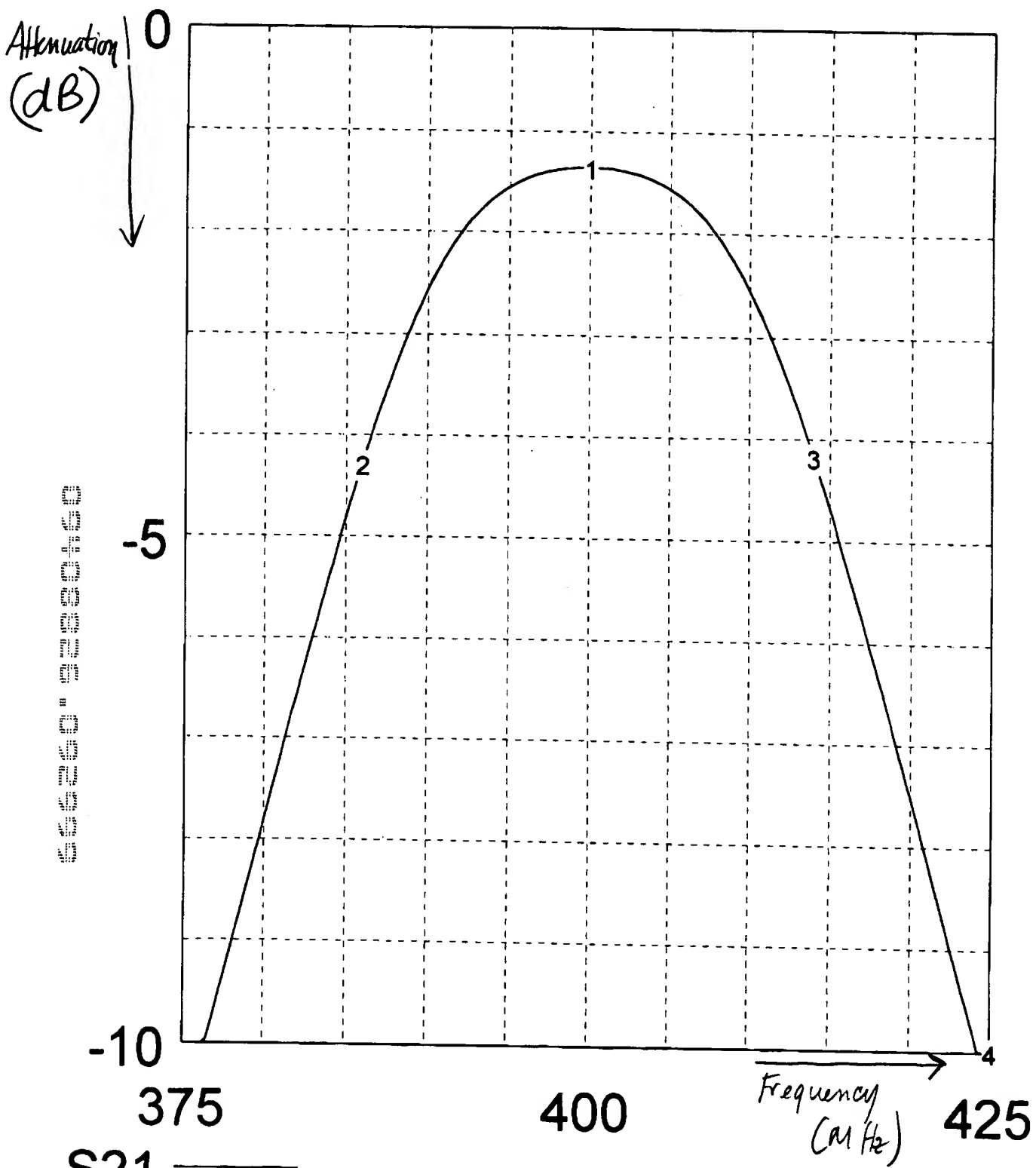
Eagleware Mar 12 18:04:58 1998 PAR400M.SCH AMPLITUDE_10DB



400	300	500	600
-1.34992	-35.2672	-32.9034	-44.6979

Fig. 14a

Eagleware Mar 12 18:05:04 1998 PAR400M.SCH AMPLITUDE_1DB

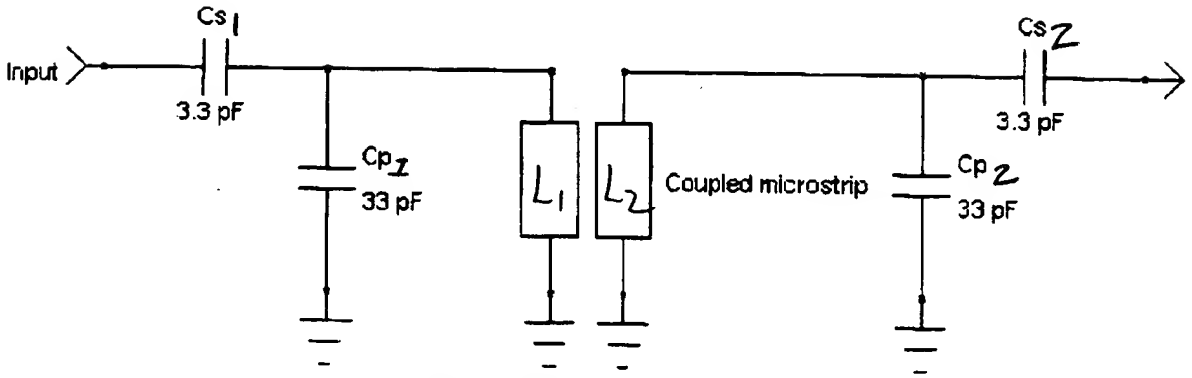


S21

400	386	414	425
-1.34992	-4.28796	-4.17562	-10.417

Fig. 146

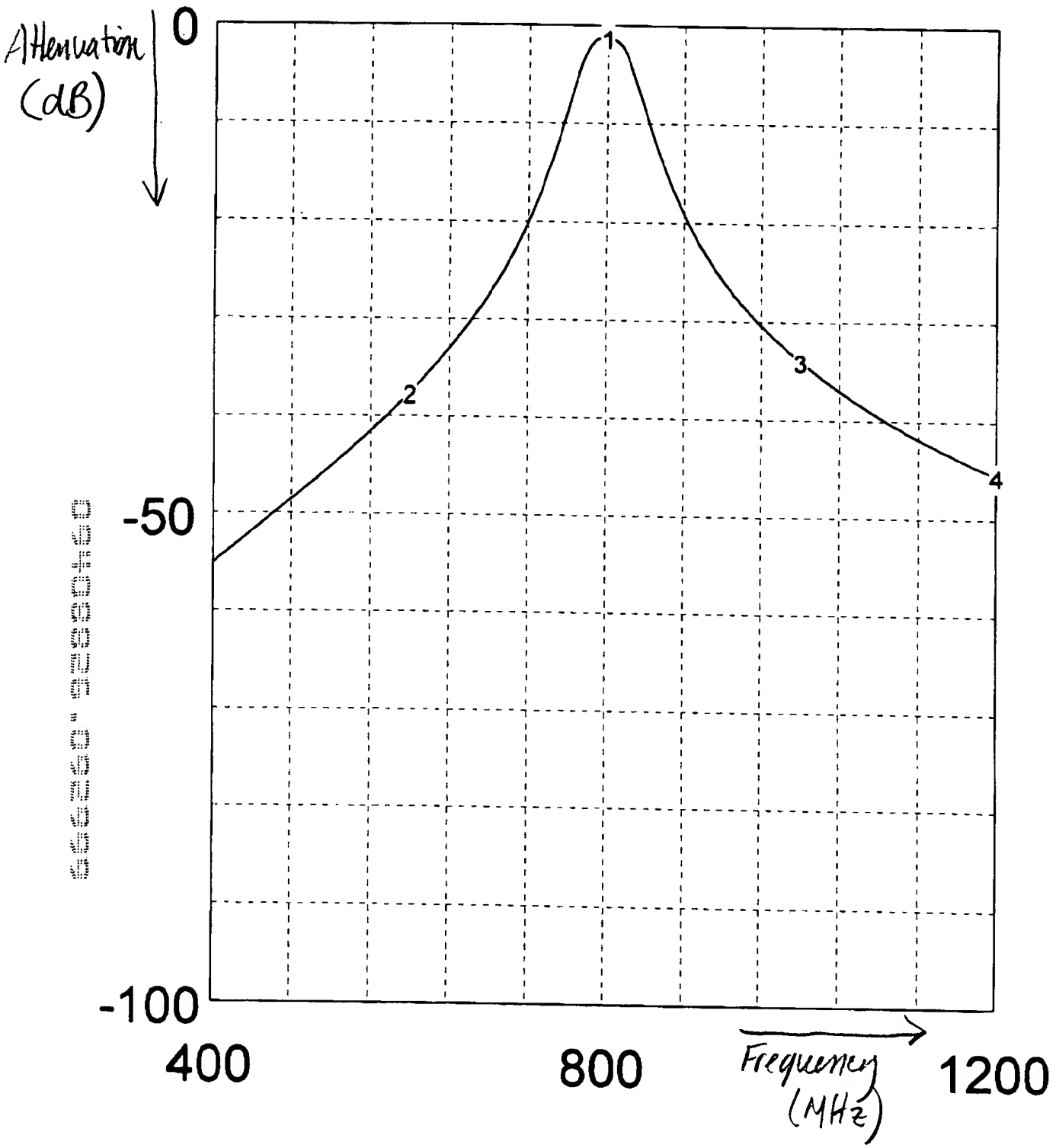
800 MHz Band Pass Filter
Parallel tuned coupled resonator
(Present Invention - Example# 6)



W=3 mm, S=5.5 mm, L=3.9 mm

Fig. 15

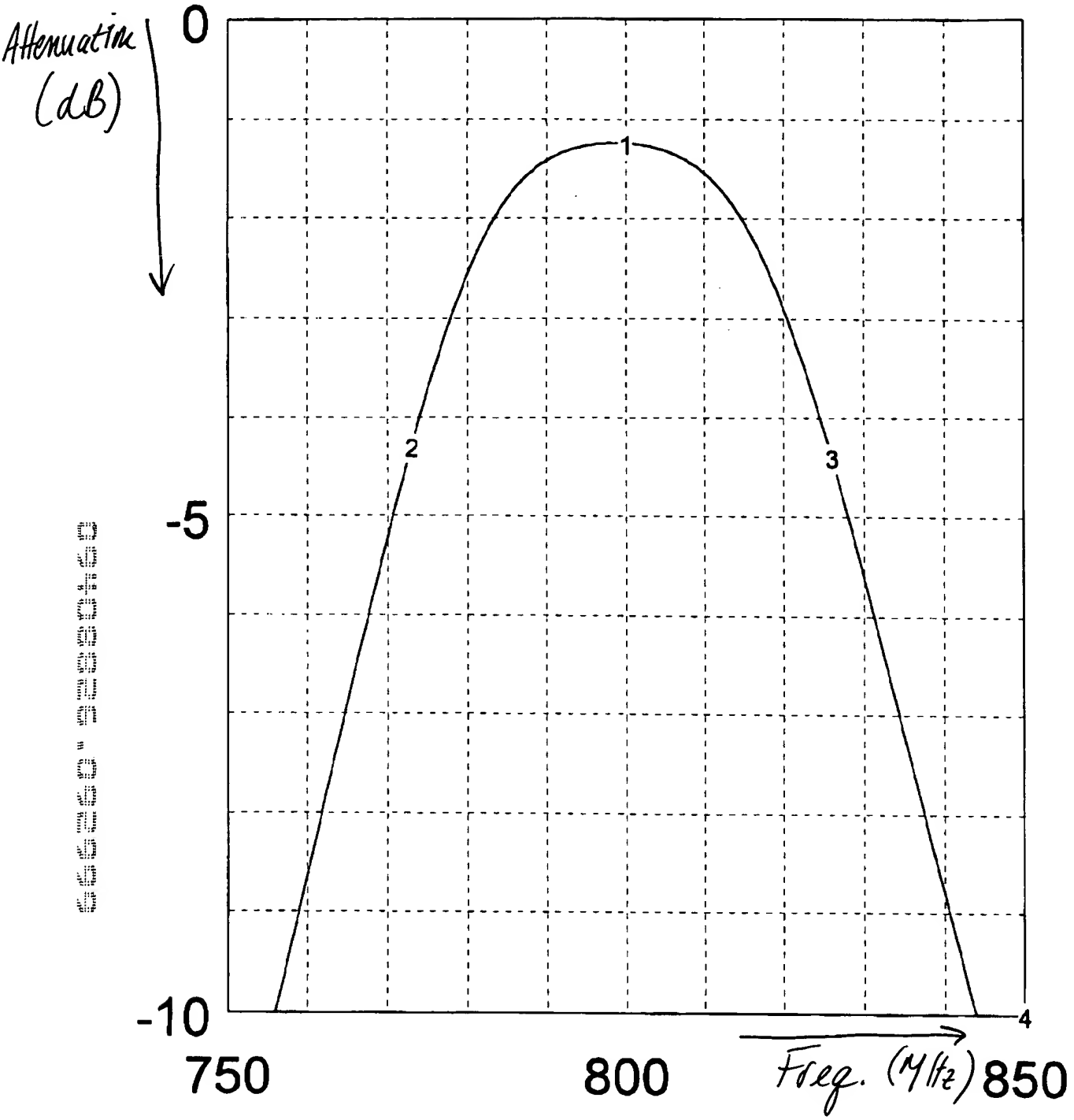
Eagleware Mar 12 18:05:45 1998 PAR800M.SCH AMPLITUDE_10DB



800	600	1000	1200
-1.23695	-37.635	-34.0381	-45.4701

Fig. 16a

Eagleware Mar 12 18:05:51 1998 PAR800M.SCH AMPLITUDE_1DB



800	773	826	850
-1.23695	-4.29699	-4.39745	-11.8421

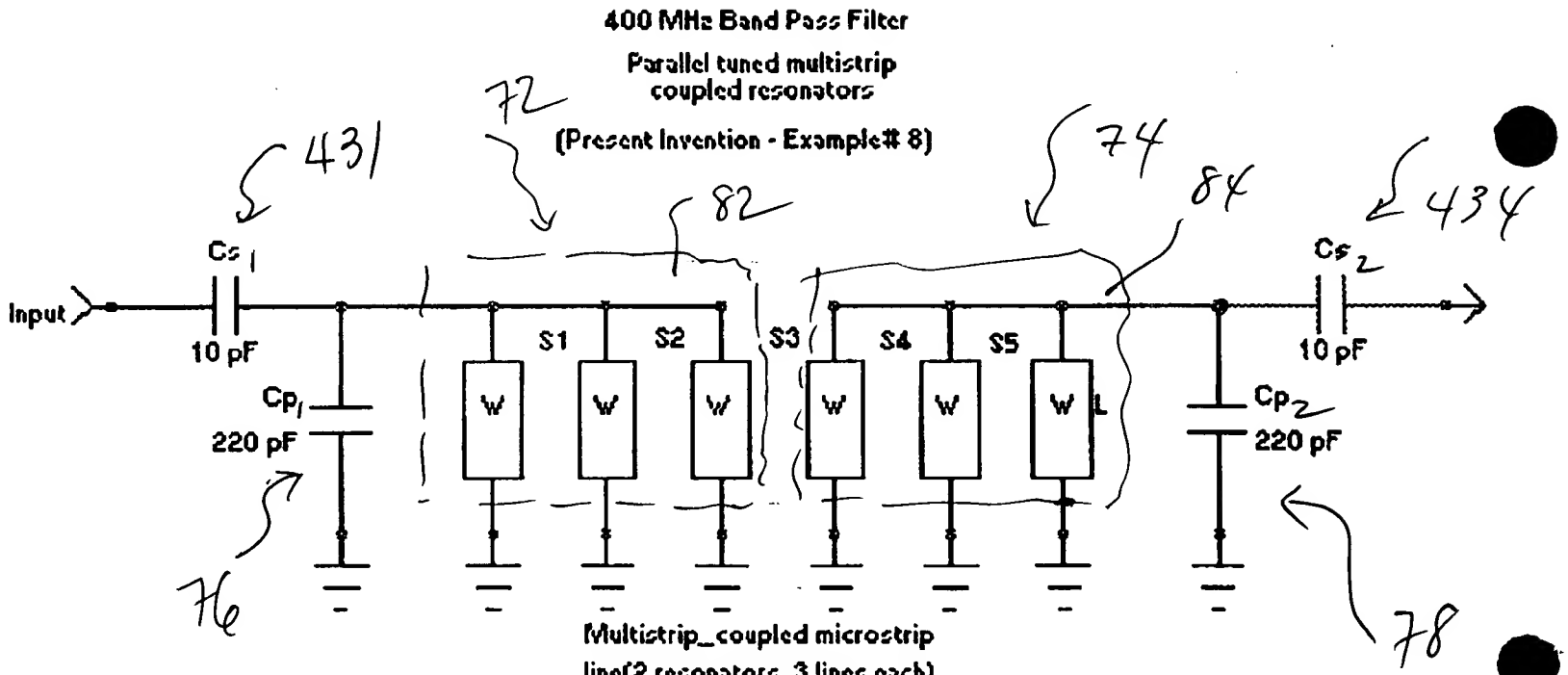
Fig. 16b

File Edit Substrate Export

multi400M.cch

90 INP OUT TXT GND SIG NET

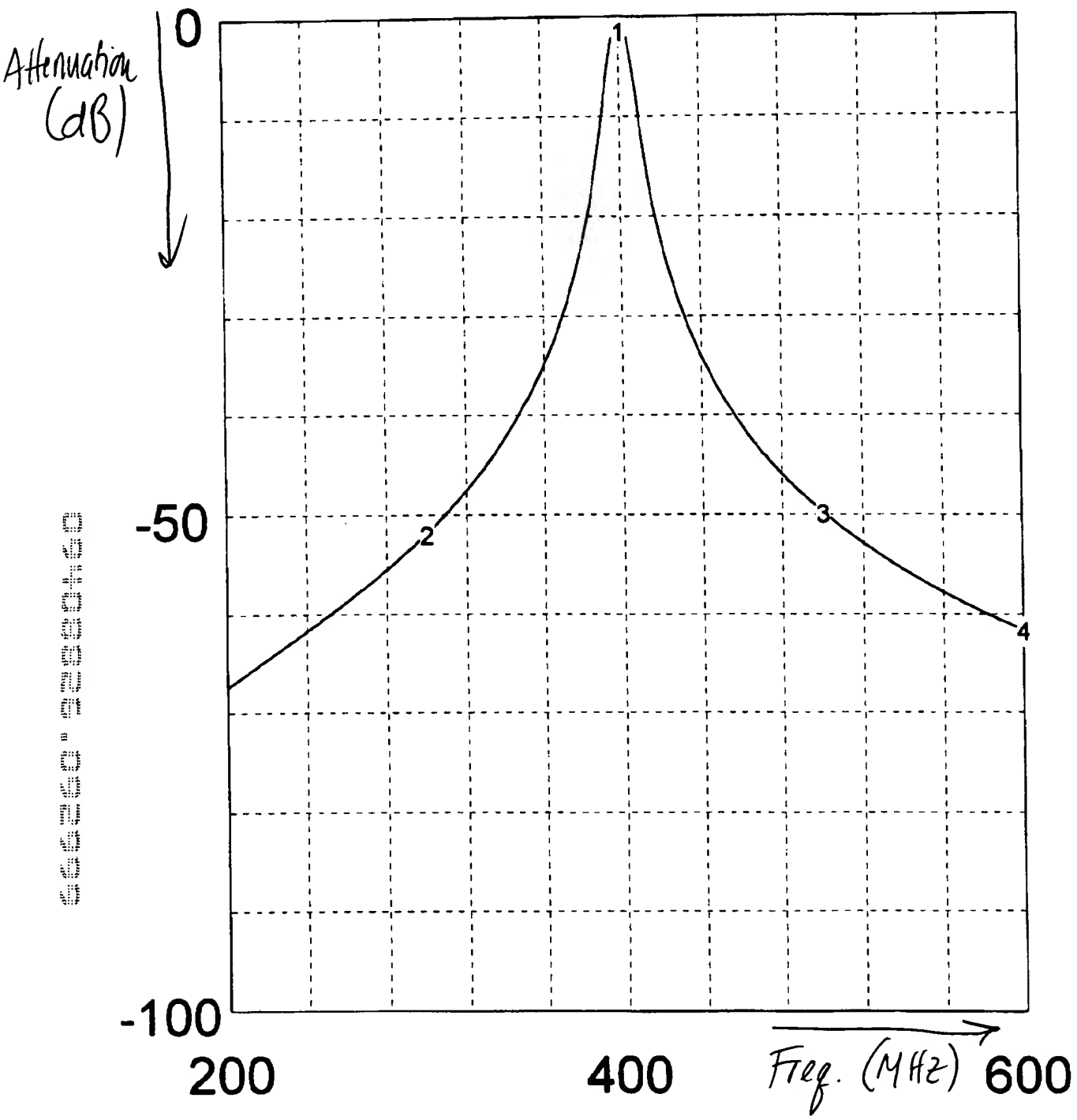
LUMPED DATA T-LINES COAX MICROSTRIP SLABLINE STRIPLINE WAVEGUIDE



F2-Save F4-Details F5-Grid F6-Mirror F7-Junctions F8-Edit F9-Exit

Fig. 17

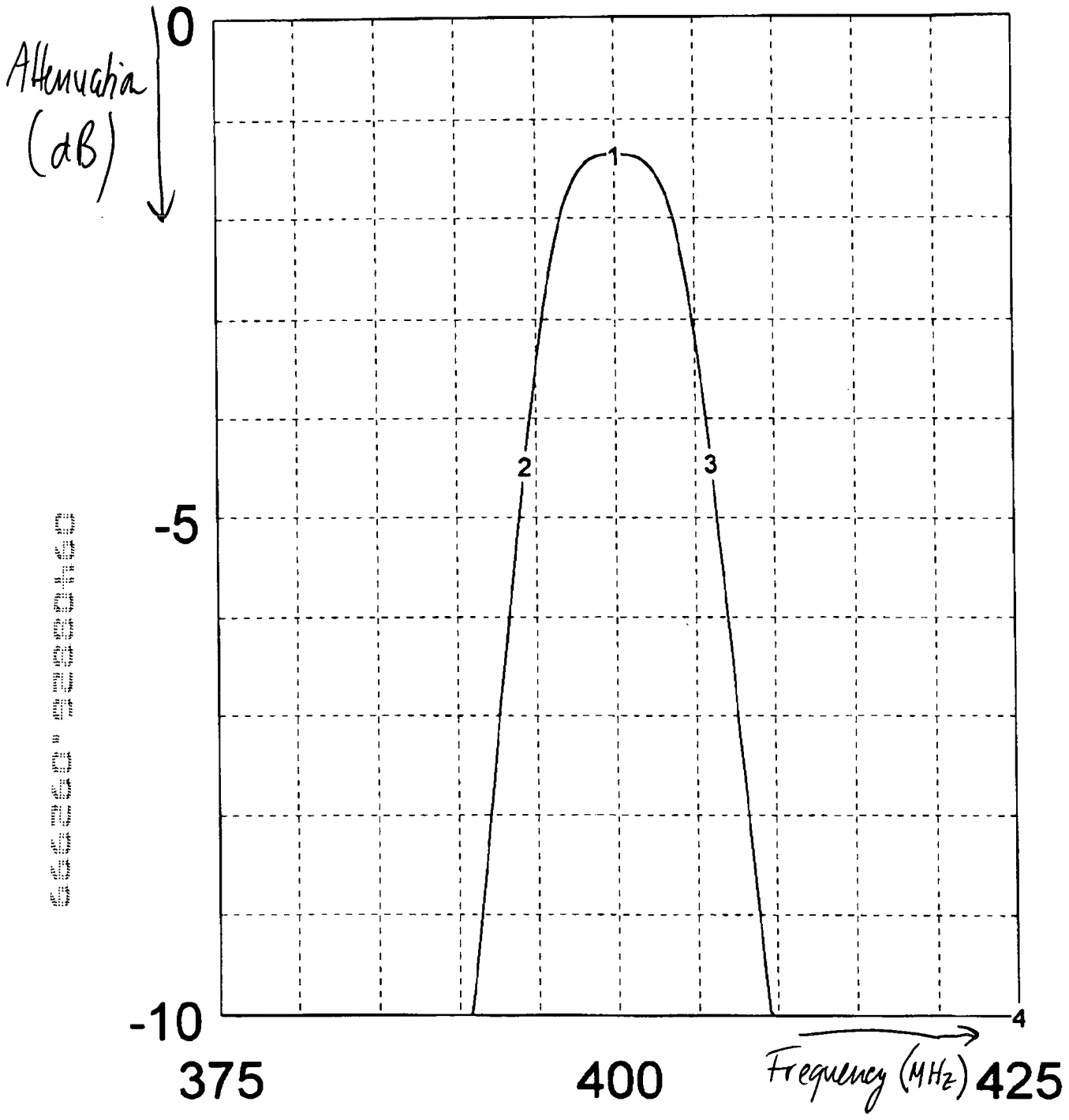
Eagleware Mar 16 17:41:00 1998 MULTI400M.SC AMPLITUDE_10DB



400	300	500	600
-1.35185	-51.8681	-49.7486	-61.6452

Fig. 18a

Eagleware Mar 16 17:41:07 1998 MULTI400M.SC AMPLITUDE_1DB



400	394.25	406	425
-1.35185	-4.47513	-4.43991	-26.022

Fig. 186

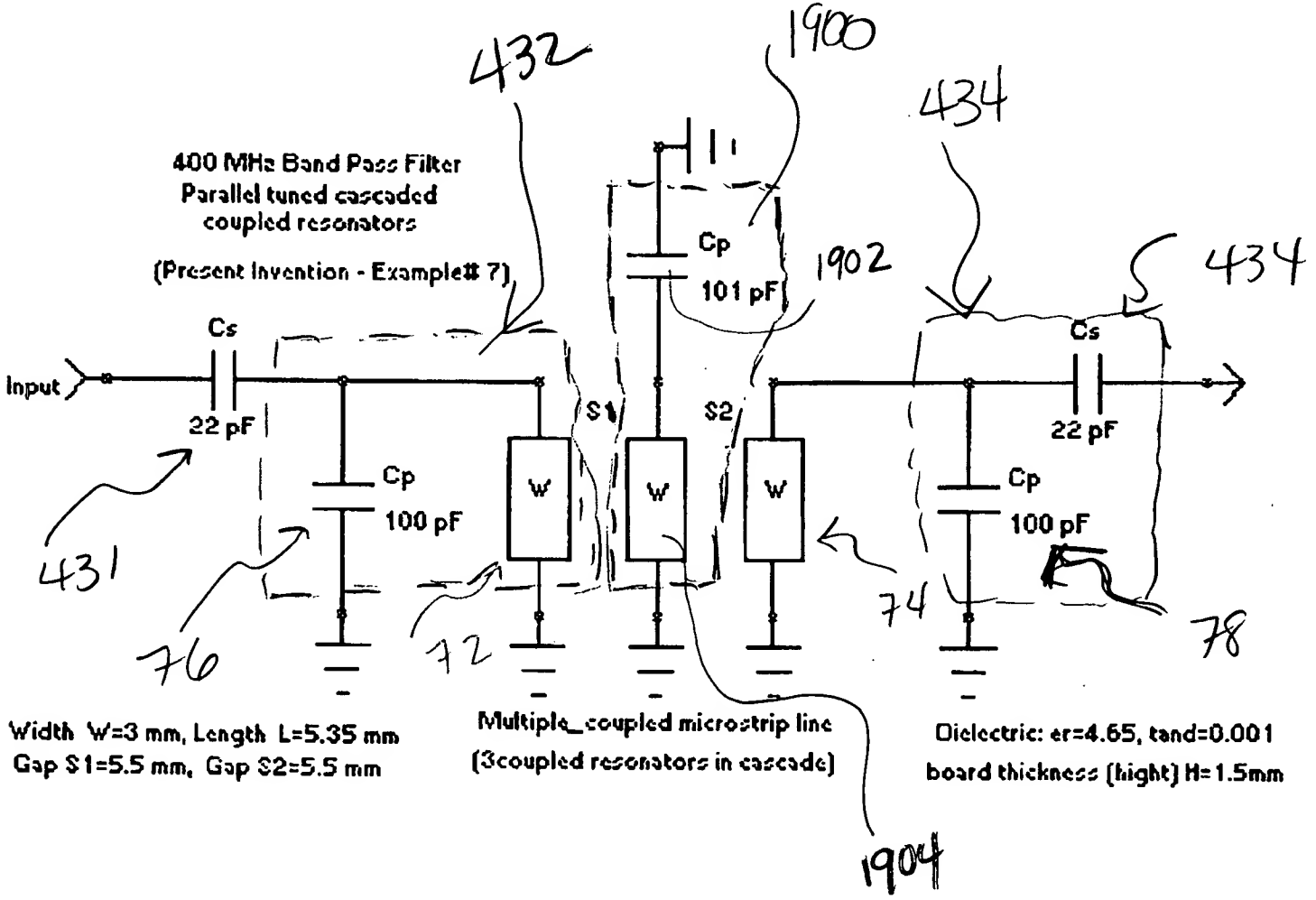
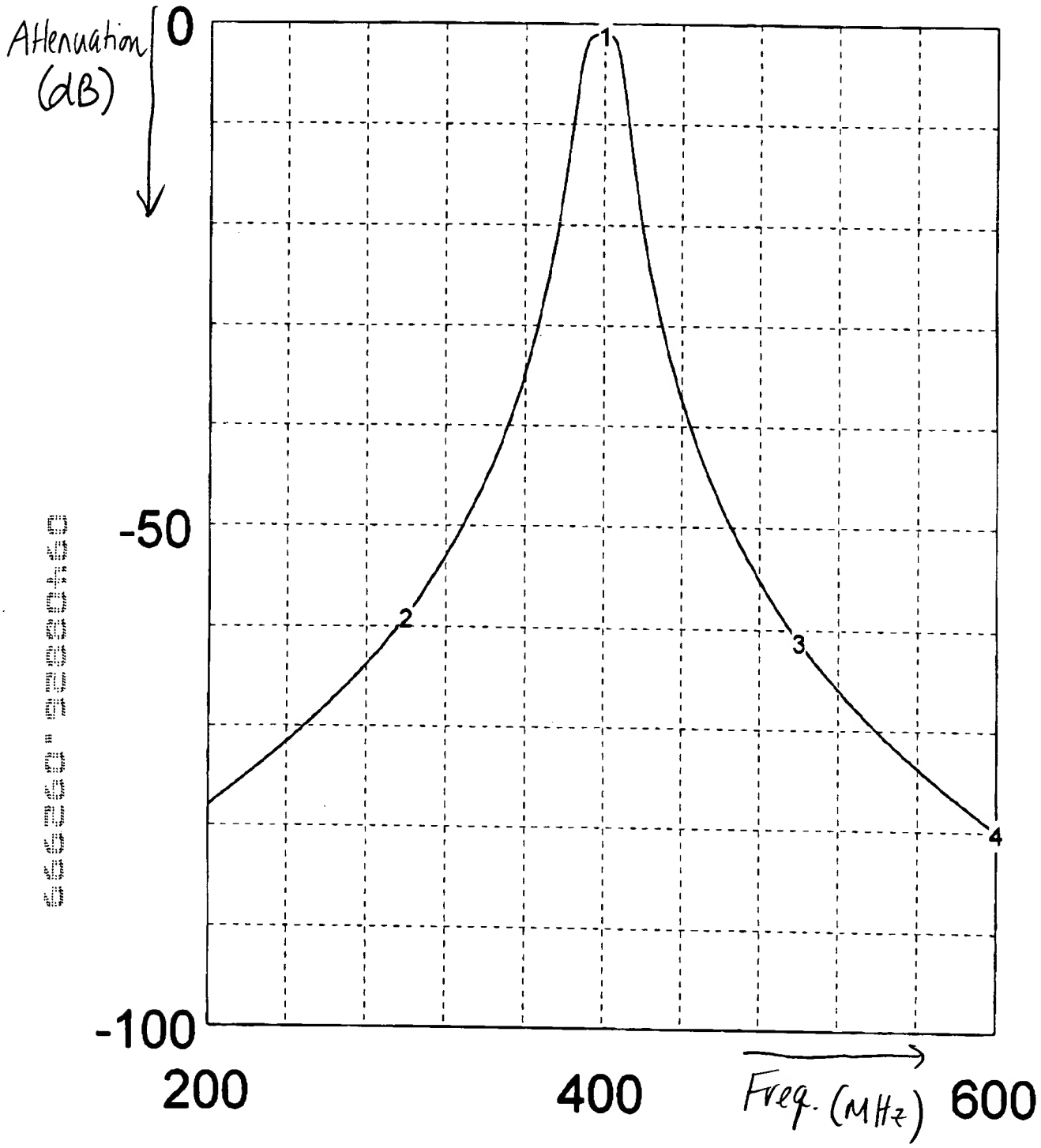

400 MHz Band Pass Filter
Parallel tuned cascaded
coupled resonators
(Present Invention - Example# 7)
Input
Cs
22 pF
Cp
100 pF
Cp
101 pF
S1
S2
W
W
W
Cs
22 pF
Cp
100 pF
Width W=3 mm, Length L=5.35 mm
Gap S1=5.5 mm, Gap S2=5.5 mm
Multiple_coupled microstrip line
(3coupled resonators in cascade)
Dielectric: er=4.65, tand=0.001
board thickness (hight) H=1.5mm
432
1900
434
434
1902
431
76
72
74
78
1904

Fig. 19

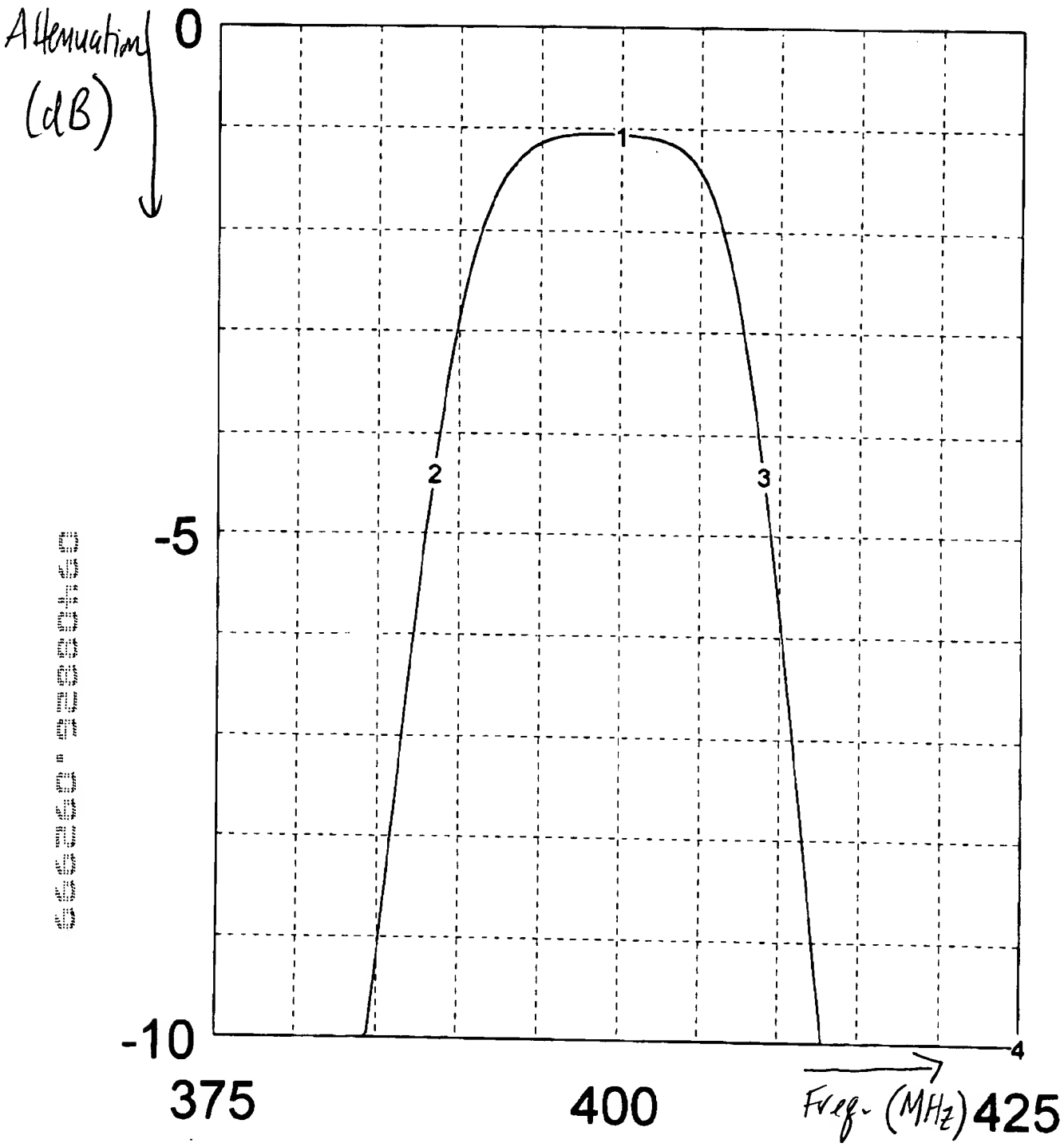
Eagleware Mar 13 15:24:06 1998 CAS400M.SCH AMPLITUDE_10DB



400	300	500	600
-1.05798	-59.0384	-61.1136	-80.0114

Fig. 20a

Eagleware Mar 13 15:24:14 1998 CAS400M.SCH AMPLITUDE_1DB



400	388.5	409	425
-1.05798	-4.38529	-4.3905	-25.5458

Fig. 206

Wide 400 MHz Band Pass Filter(100 MHz BW:Balanced_Unbalanced transformer)

(Present Invention - Example# 9)

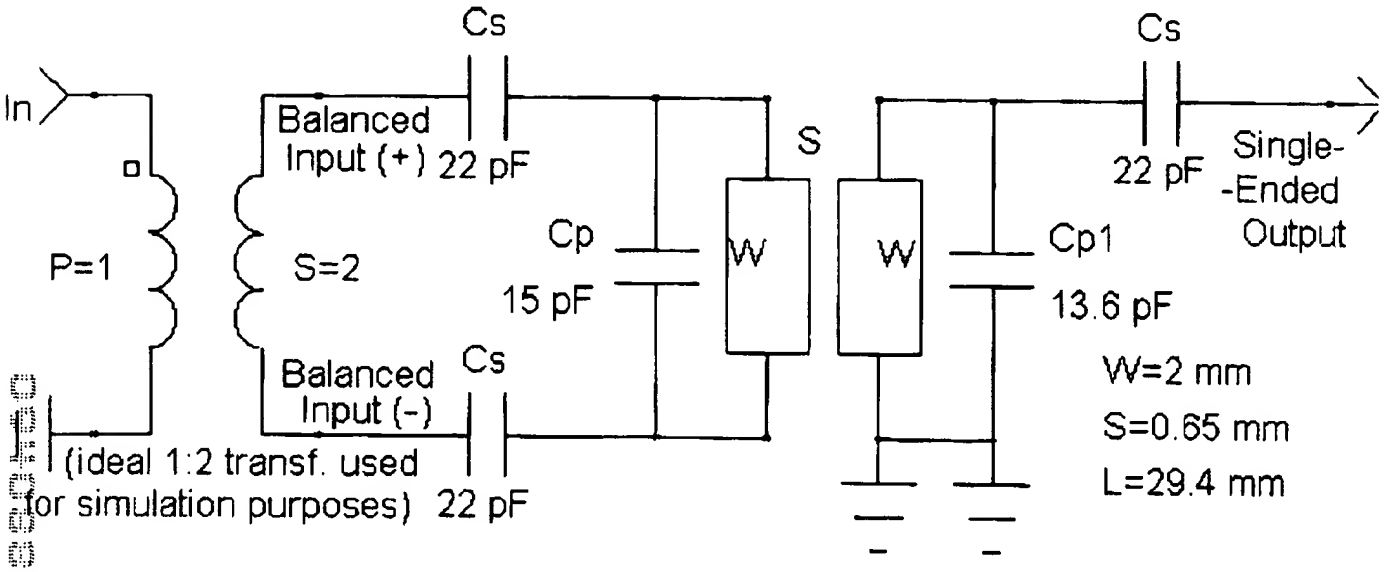
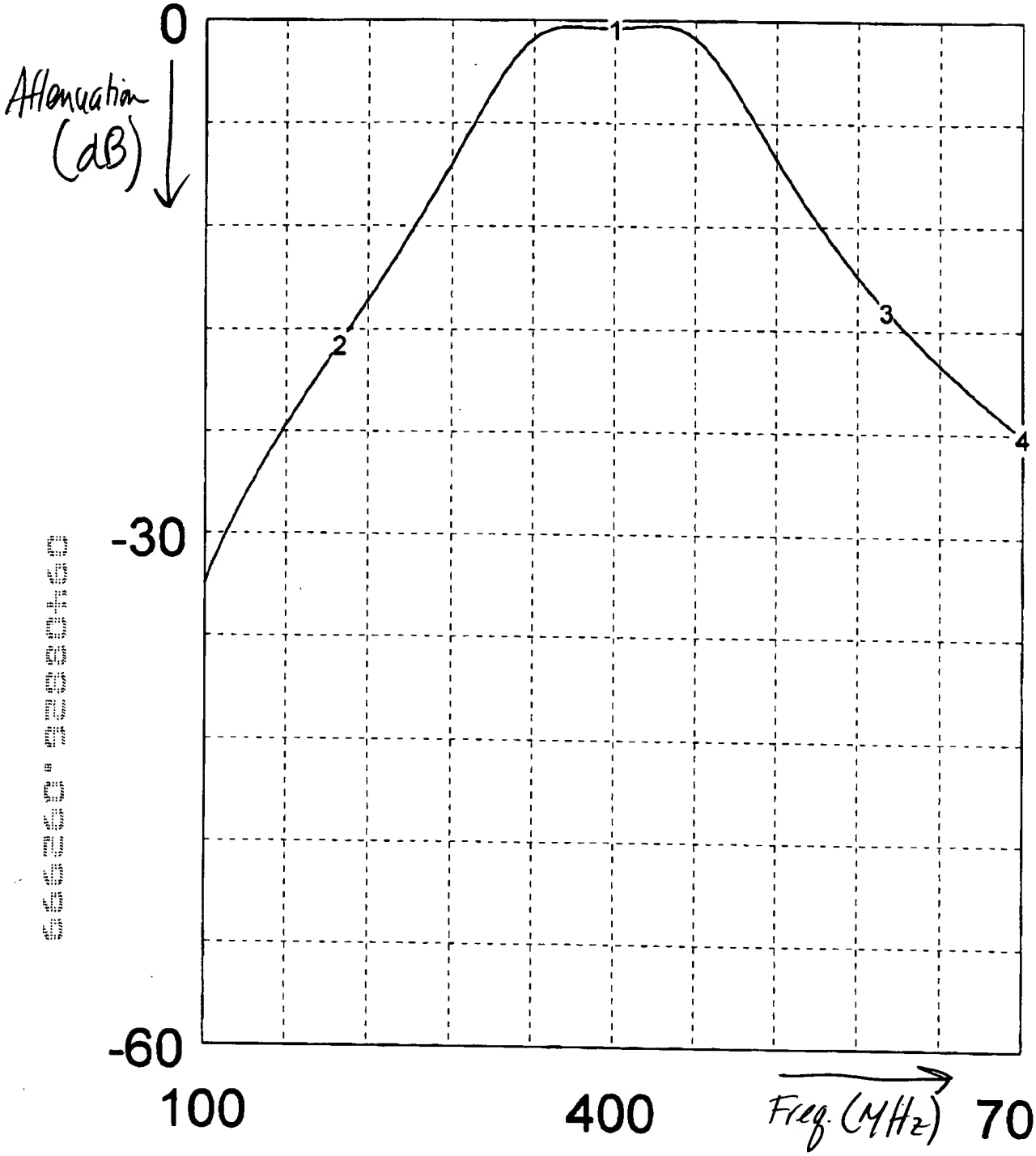


Fig. 21

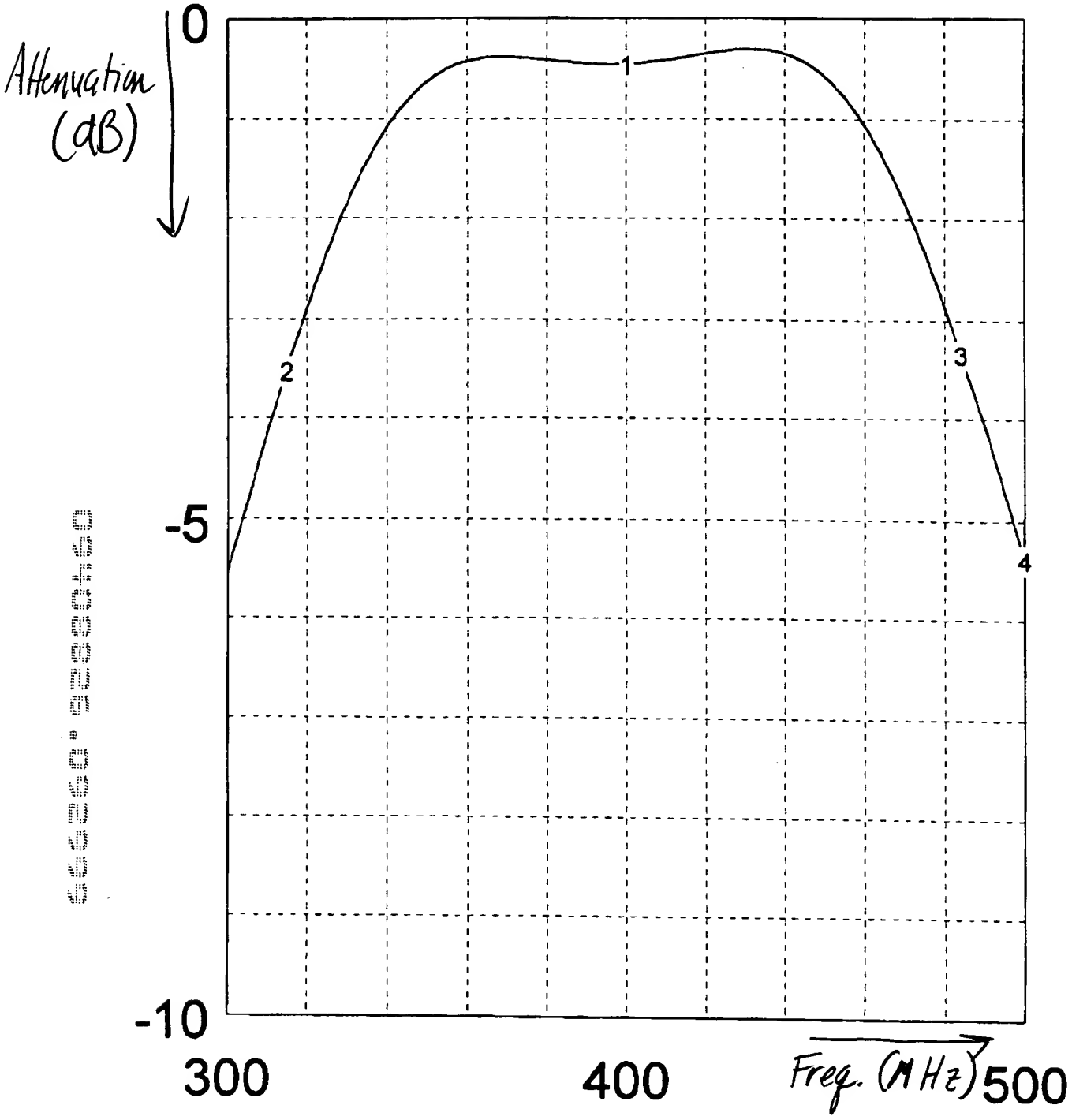
Eagleware Mar 13 16:16:20 1998 B_U400W.SCH IN(75,75)



400	199	601	700
-0.450828	-18.845	-16.7906	-24.0876

Fig. 22a

Eagleware Mar 13 16:16:28 1998 B_U400W.SCH IN(75,75)



400	315	484	500
-0.450828	-3.51348	-3.32686	-5.3712

Fig. 22b

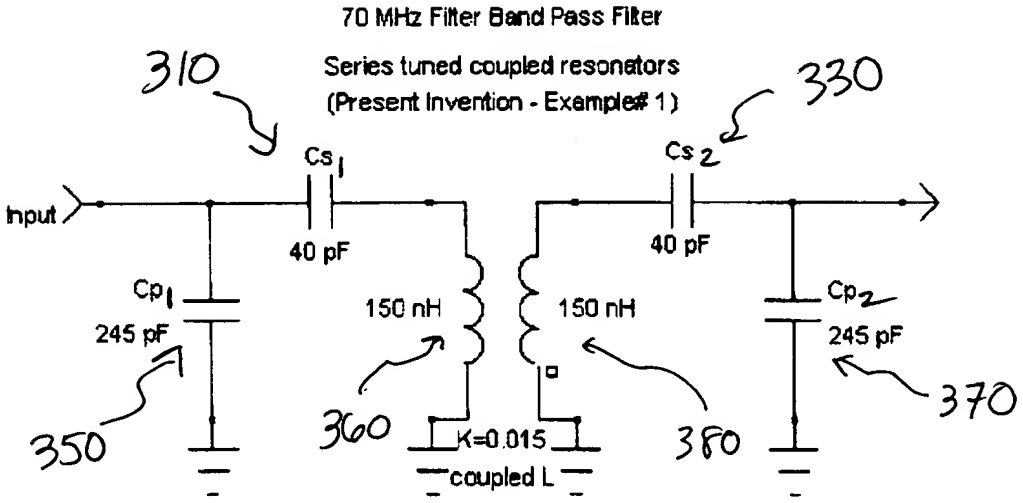
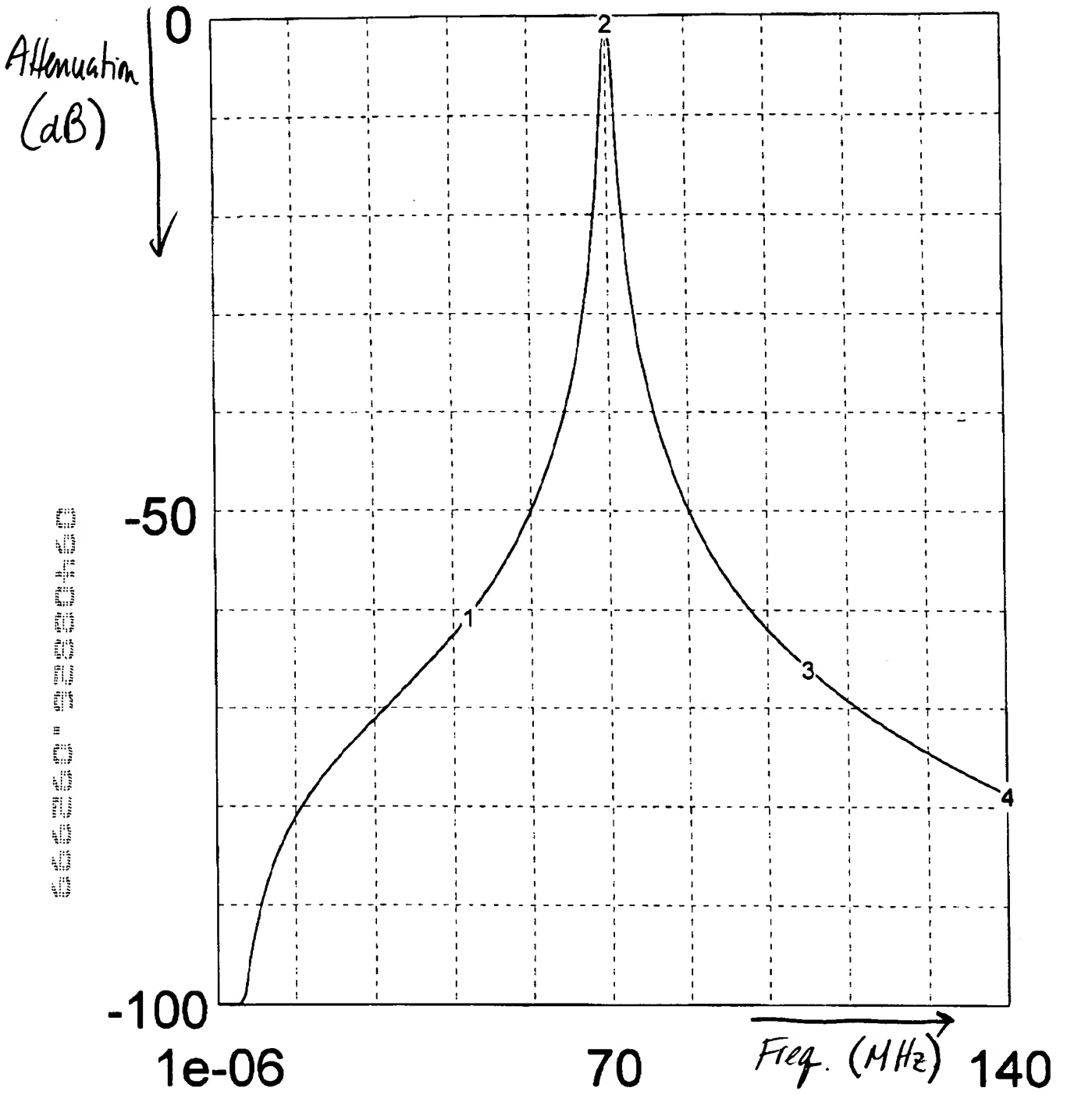

70 MHz Filter Band Pass Filter
Series tuned coupled resonators
(Present Invention - Example# 1)
310
330
Cs1
Cs2
Input
40 pF
40 pF
Cp1
245 pF
150 nH
150 nH
Cp2
245 pF
350
360
K=0.015
coupled L
380
370

Fig. 24

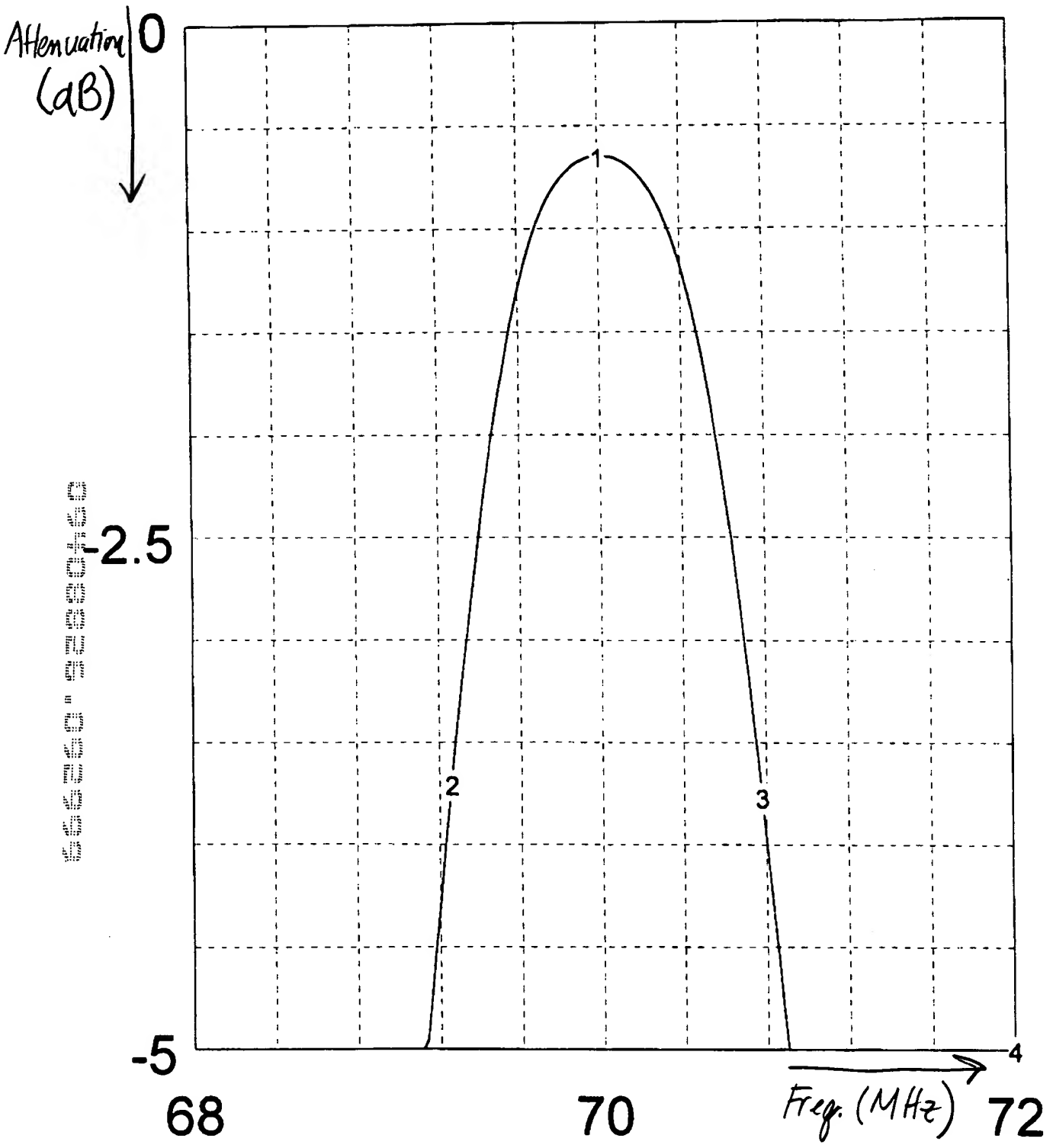
Eagleware Mar 12 12:32:04 1998 SER70M.SCH AMPLITUDE_10DB



44.8	70	105	140
-60.6209	-0.648476	-66.0358	-78.7293

Fig. 25a

Eagleware Mar 12 12:31:58 1998 SER70M.SCH AMPLITUDE_1DB



70	69.26	70.78	72
-0.648476	-3.70701	-3.76667	-16.2641

Fig 25h

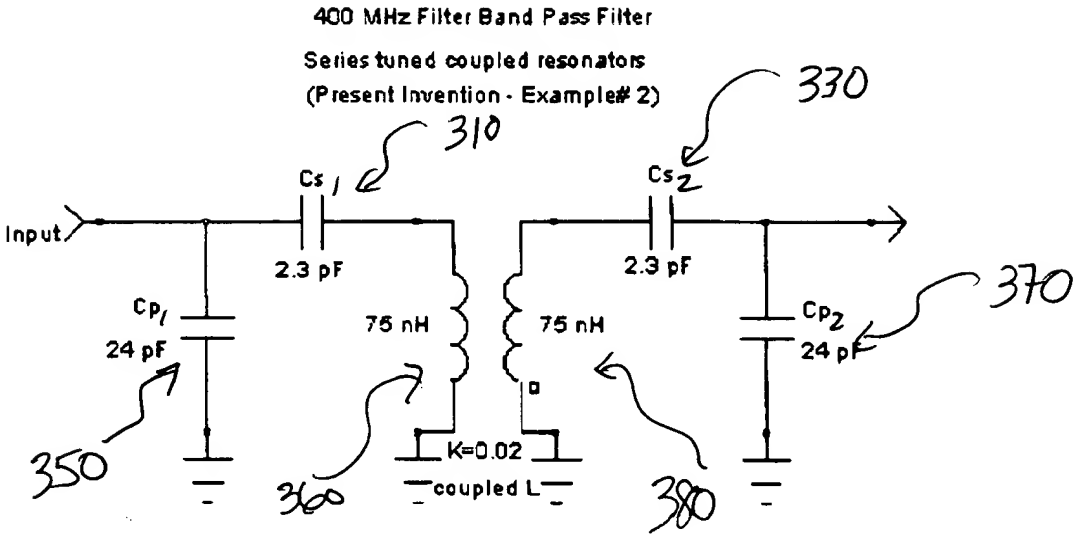
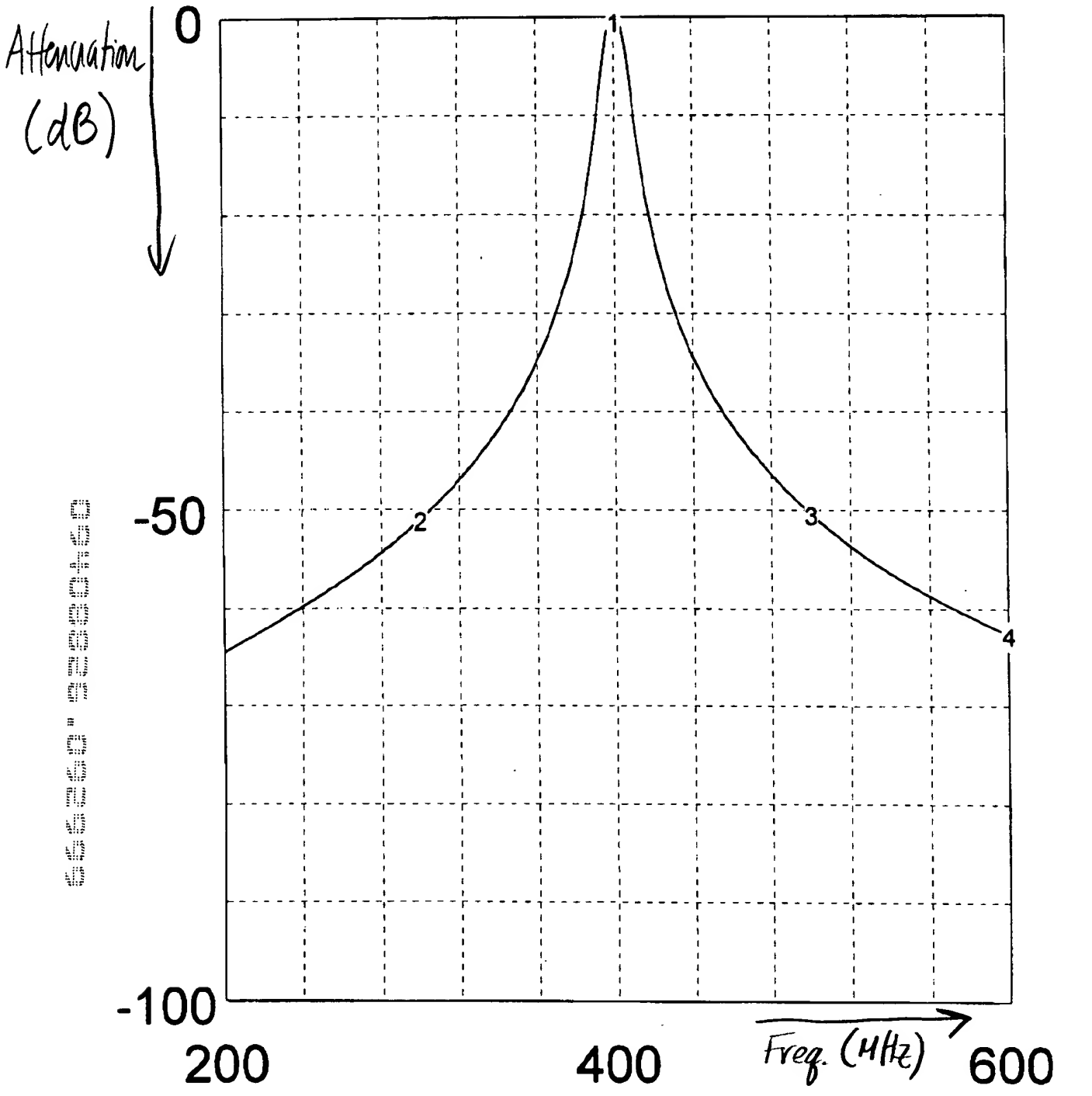

400 MHz Filter Band Pass Filter
Series tuned coupled resonators
(Present Invention - Example# 2)
310
330
Cs 1
Cs 2
Input
2.3 pF
2.3 pF
Cp1
24 pF
75 nH
75 nH
Cp2
24 pF
370
a
K=0.02
coupled L
350
360
380

Fig. 26

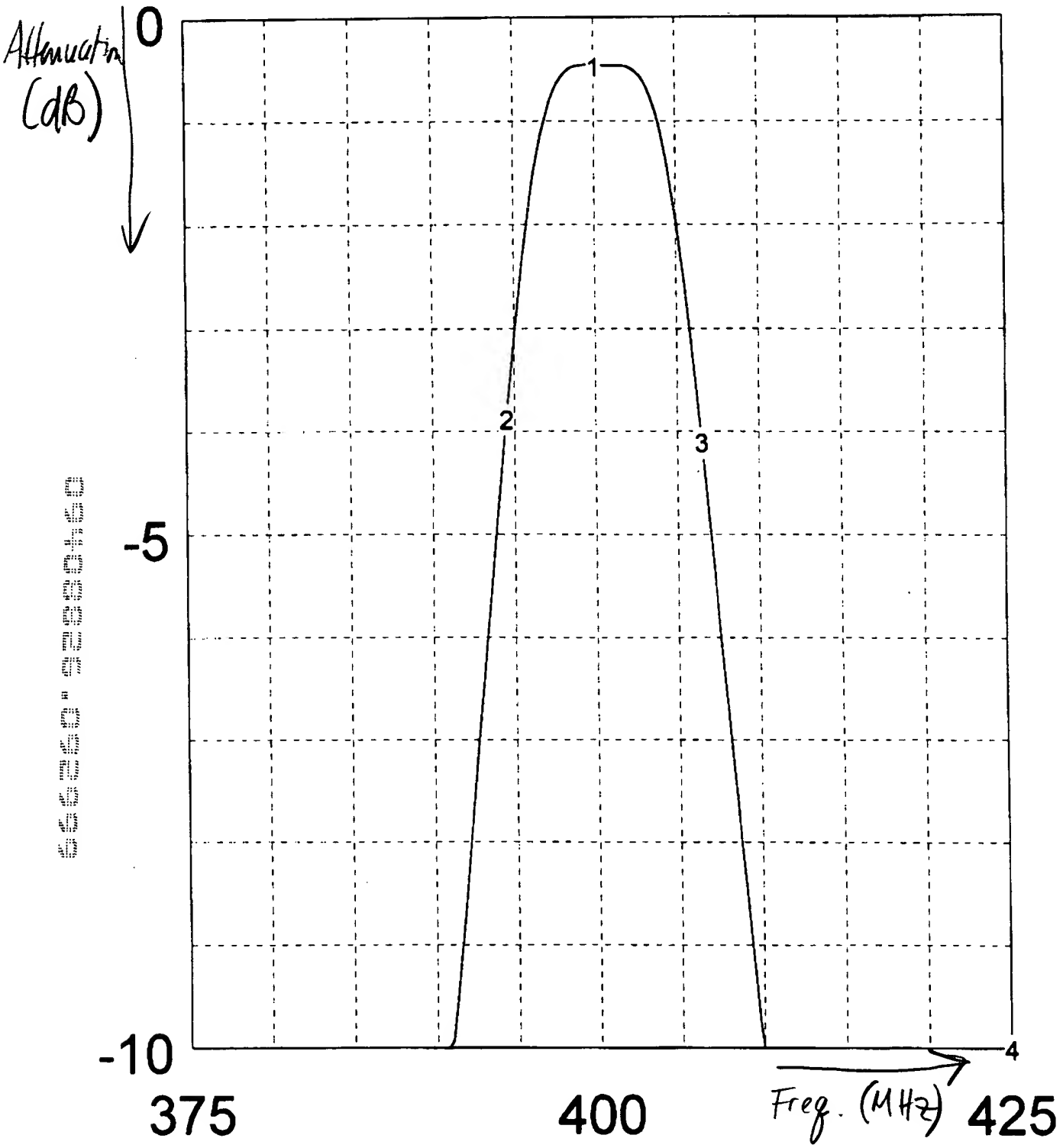
Eagleware Mar 12 12:46:20 1998 SER400M.SCH AMPLITUDE_10DB



400	300	500	600
-0.459122	-51.0187	-50.4078	-62.6643

Fig. 27a

Eagleware Mar 12 12:46:26 1998 SER400M.SCH AMPLITUDE_1DB



400	394.5	406.5	425
-0.459122	-3.86683	-4.08966	-26.0854

Fig. 27b

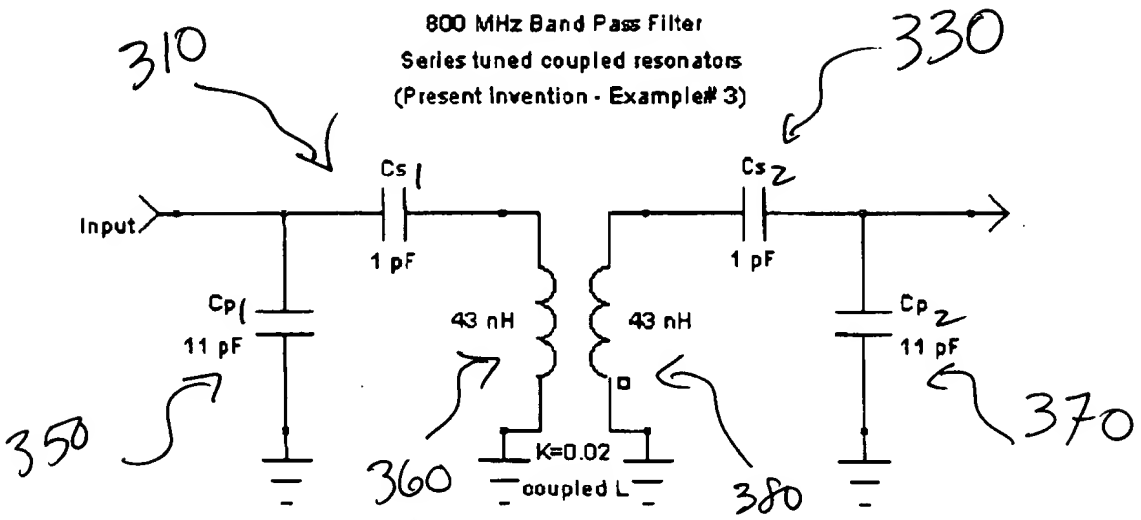
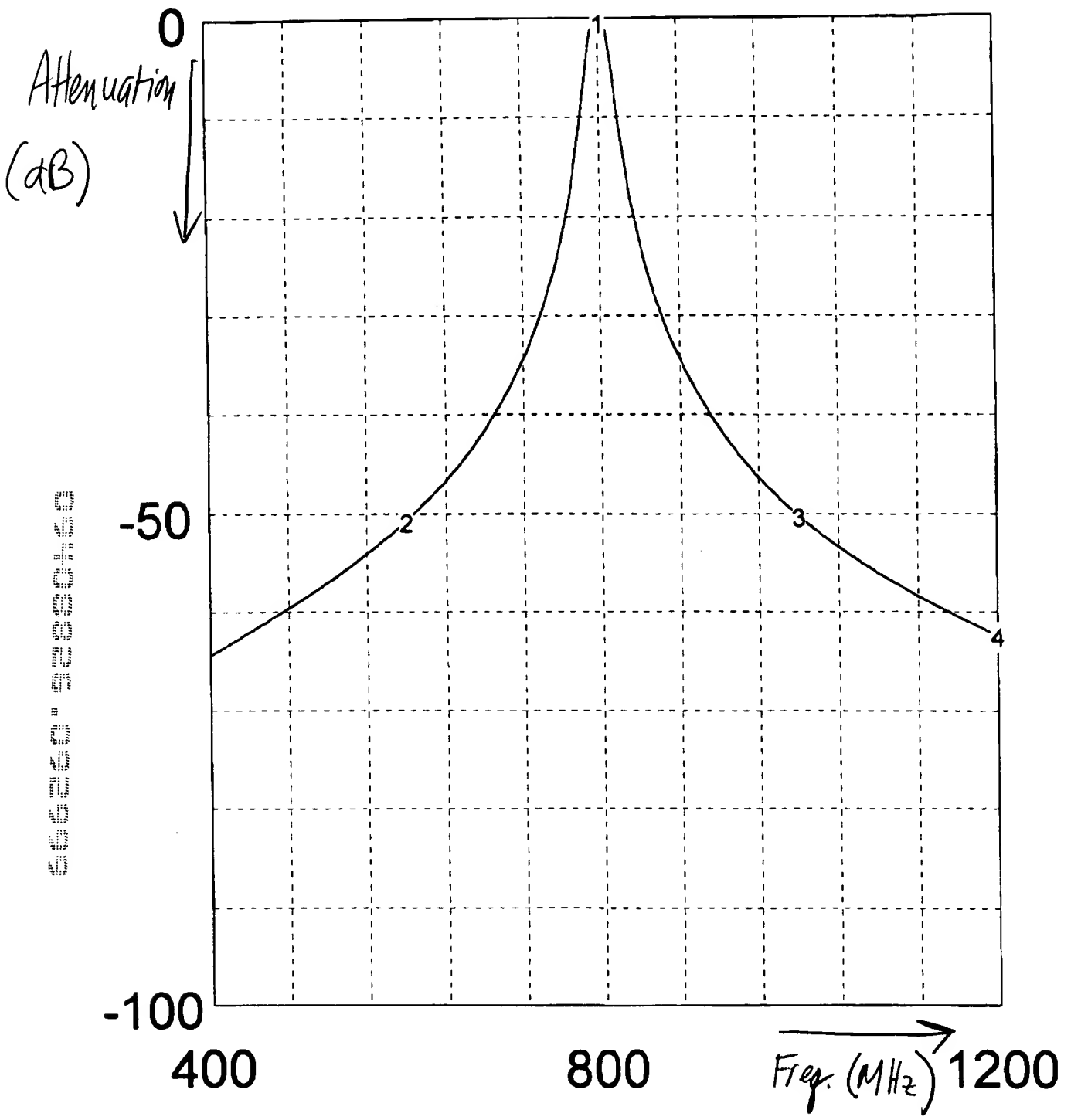

800 MHz Band Pass Filter
Series tuned coupled resonators
(Present Invention - Example# 3)
310
330
Cs 1
Cs 2
Input
1 pF
1 pF
Cp 1
11 pF
43 nH
43 nH
Cp 2
11 pF
350
360
K=0.02
coupled L
380
370

Fig. 28

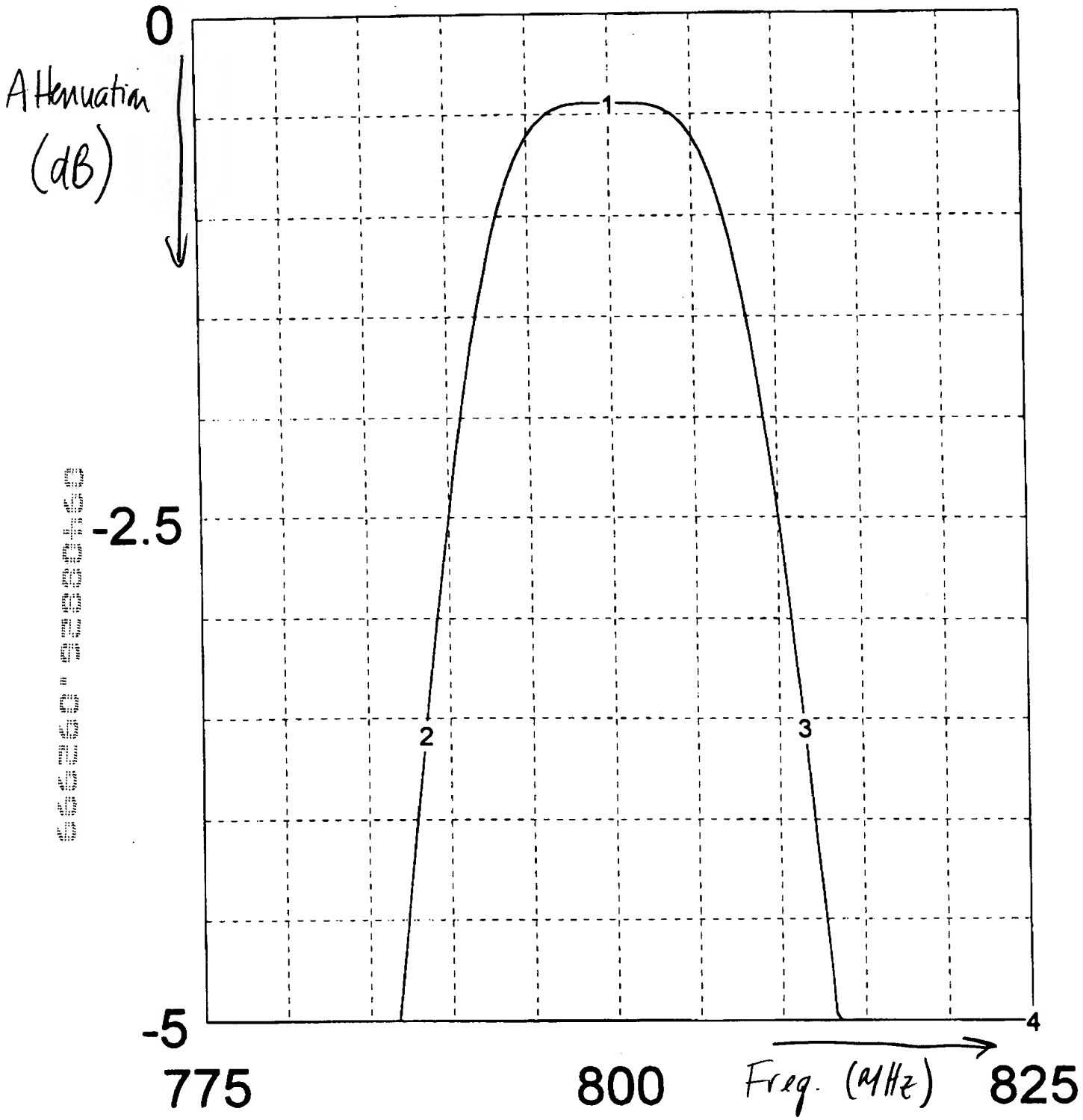
Eagleware Mar 12 16:00:30 1998 SER800M.SCH AMPLITUDE_10DB



800	600	1000	1200
-0.443973	-50.732	-50.196	-62.4026

Fig. 29a

Eagleware Mar 12 16:00:36 1998 SER800M.SCH AMPLITUDE_1DB



800	788.5	811.5	825
-0.443973	-3.57842	-3.54287	-14.2697

Fig. 296

Equivalent Inductance of Micro-Strip transmission lines used in example filters:

Dielectric constant = 4.65; Height = 1.5 mm; Copper thickness: 0.018 mm

Filter Example #	Filter Center Frequency (MHz)	Length of uStrip line (mm)	Width of uStrip line (mm)	Percentage of wave-length (%)	Equivalent Inductance of uStrip line (nH)
4	70	12.25	1.5	0.6	6.1
5	400	4	1	1.1	2.4
6	800	3.9	3	2.3	1.3
7	400	5.35	3	1.5	1.8
8 (multiple microstrip lines connected in paralel)	400	5.5	3 lines connected in paralel, each 2 mm wide	1.6	(2.4 nH each) **0.72nH total** (see note)
9	400	29.4	2	8.5	14
10 (multiple microstrip lines connected in paralel)	400	5.5	3 lines connected in paralel, each 2 mm wide	1.6	(2.4 nH each) **0.72nH total** (see note)

Note: Adding more microstrip lines connected in parallel (multistrip lines), very low inductance values, in the order of **0.5 nH**, of high accuracy and repeatability are achievable. Considering the achievable tolerances in manufacturing (length and width of the lines), a tolerance of **+/- 2%** of the inductance value of the multistrip lines is possible.

Fig. 30

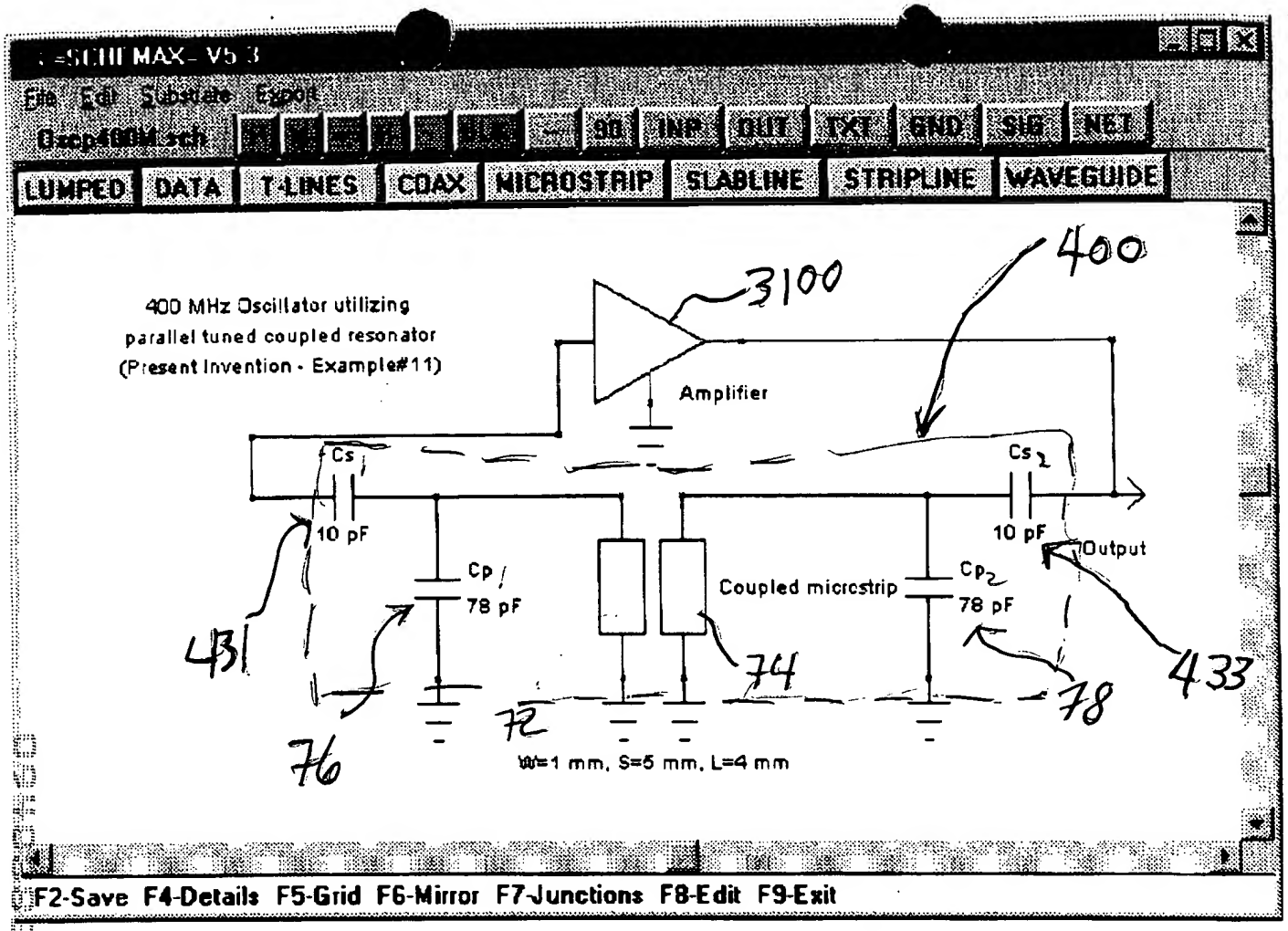

MAX- V5.3
File Edit Substrate Export
3D INP OUT TXT GND SIG NET
LUMPED DATA T-LINES COAX MICROSTRIP SLABLINE STRIPLINE WAVEGUIDE
400 MHz Oscillator utilizing
parallel tuned coupled resonator
(Present Invention - Example#11)
3100
400
Amplifier
Cs1
Cs2
10 pF
10 pF
Output
Cp1
78 pF
Coupled microstrip
Cp2
78 pF
431
74
78
433
76
72
W=1 mm, S=5 mm, L=4 mm
F2-Save F4-Details F5-Grid F6-Mirror F7-Junctions F8-Edit F9-Exit

Fig. 31

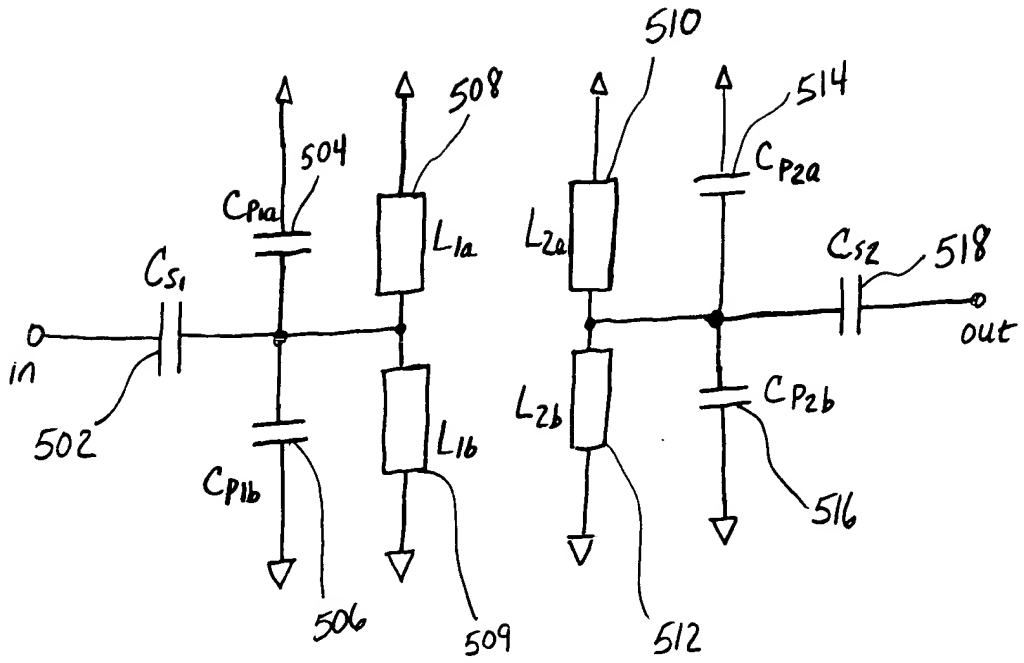


Fig. 32a

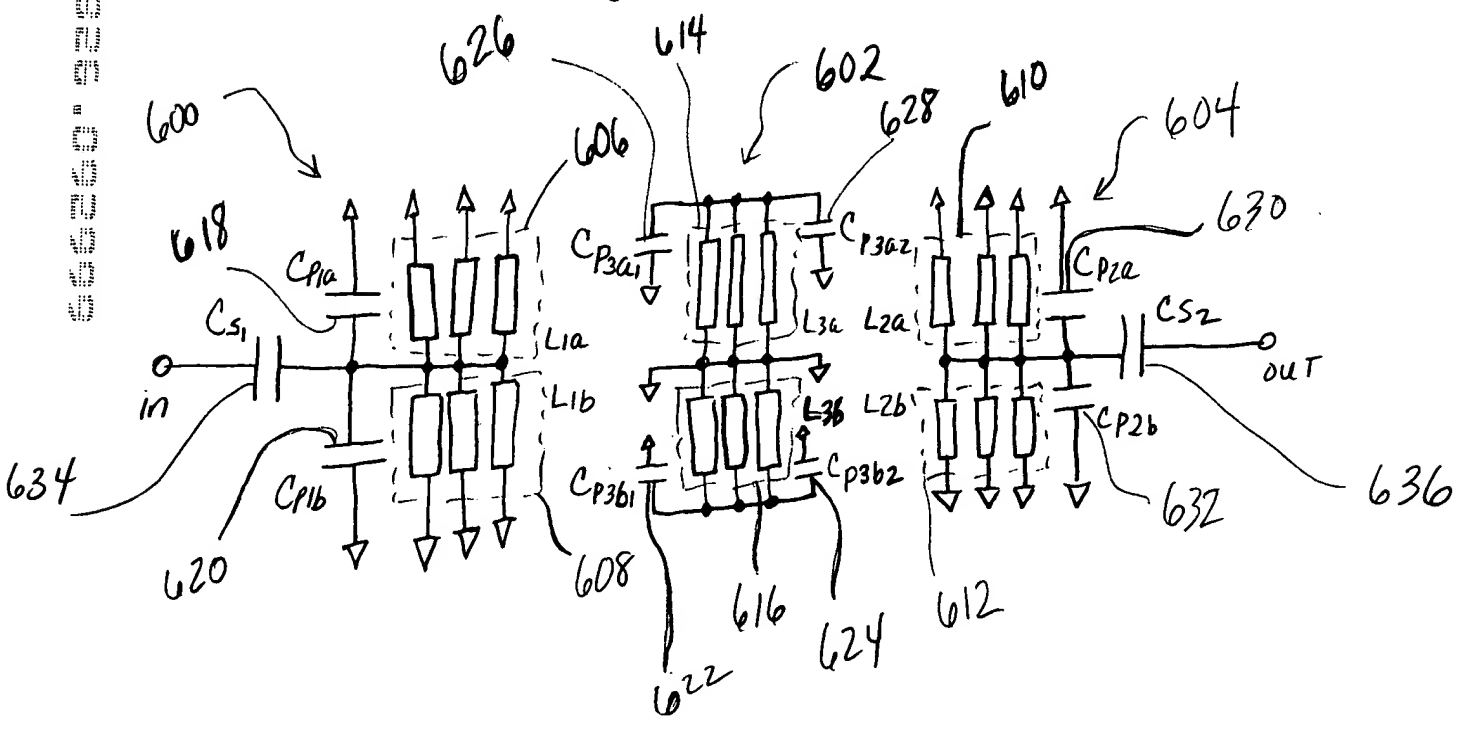


Fig. 32b

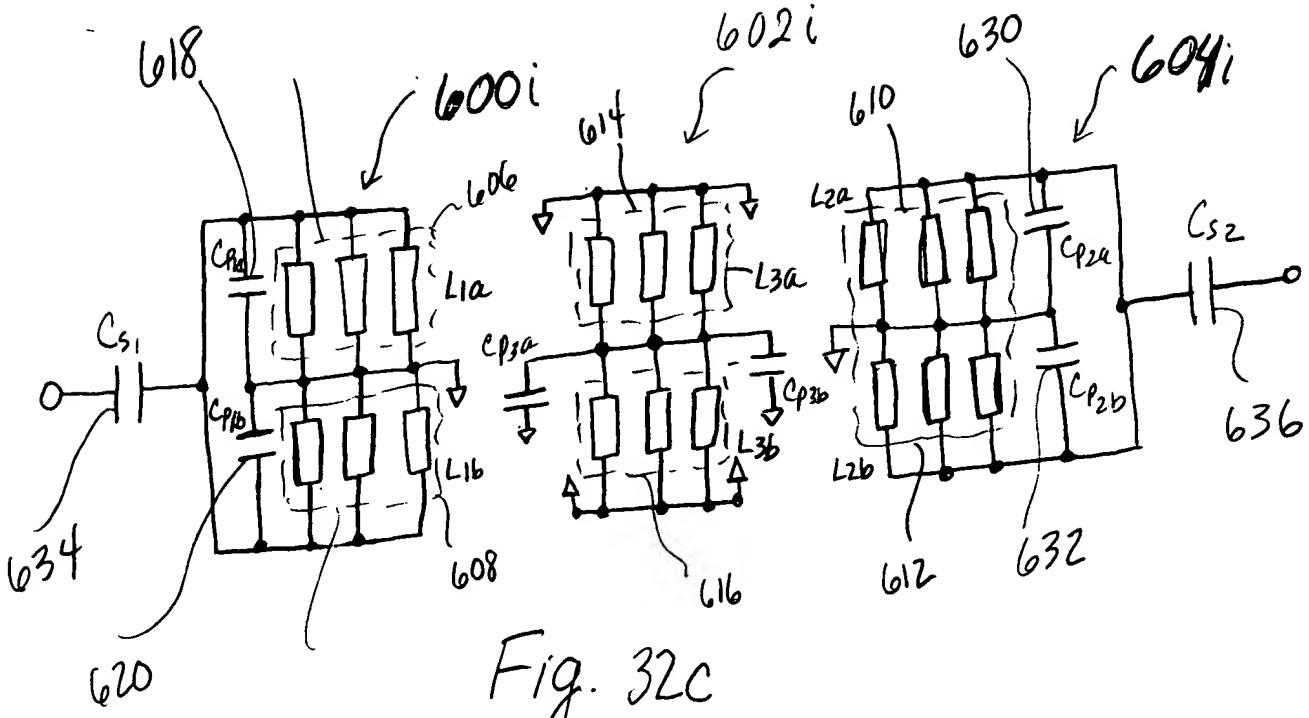
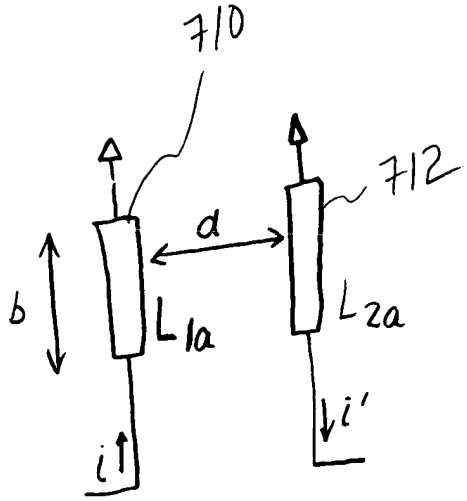
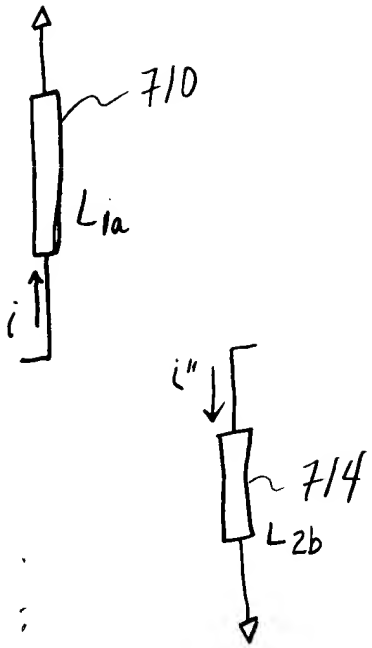

618
600i
602i
630
604i
606
614
610
L1a
L3a
L2a
Cs1
Cp1a
Cp3a
Cp2a
Cs2
Cp1b
Cp3b
Cp2b
L1b
L3b
L2b
634
608
616
612
632
636
620

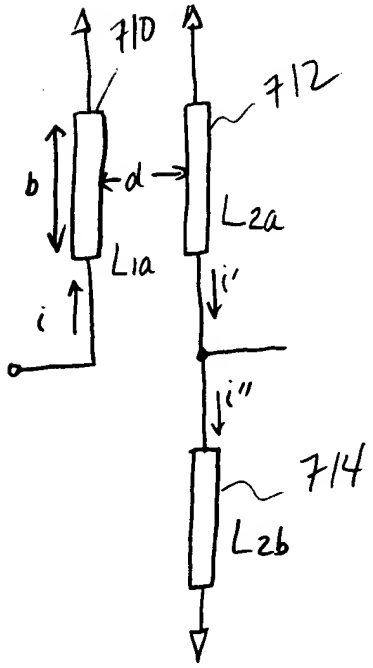
Fig. 32c


710
712
d
b
L_{1a}
L_{2a}
i
i'

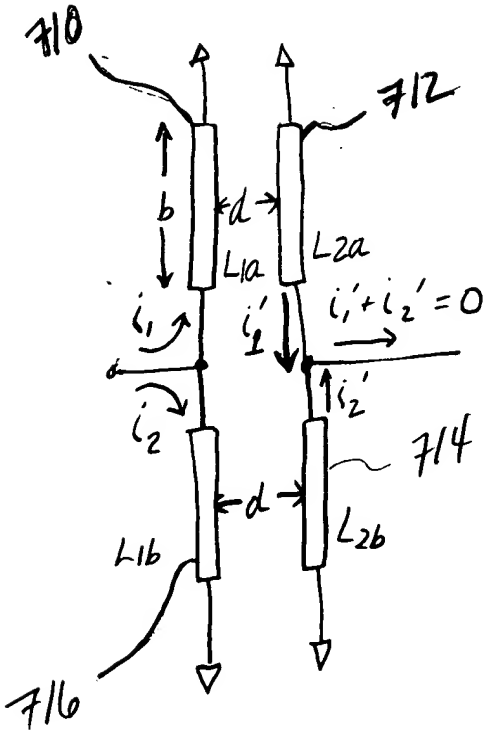
(a)


710
L_{1a}
i
i"
714
L_{2b}

(b)


710
712
b
d
L_{1a}
L_{2a}
i
i'
i"
714
L_{2b}

(c)


710
712
b
d
L_{1a}
L_{2a}
i_1
i_1'
$i_1' + i_2' = 0$
i_2
i_2'
714
d
L_{1b}
L_{2b}
716

(d)

Fig. 33

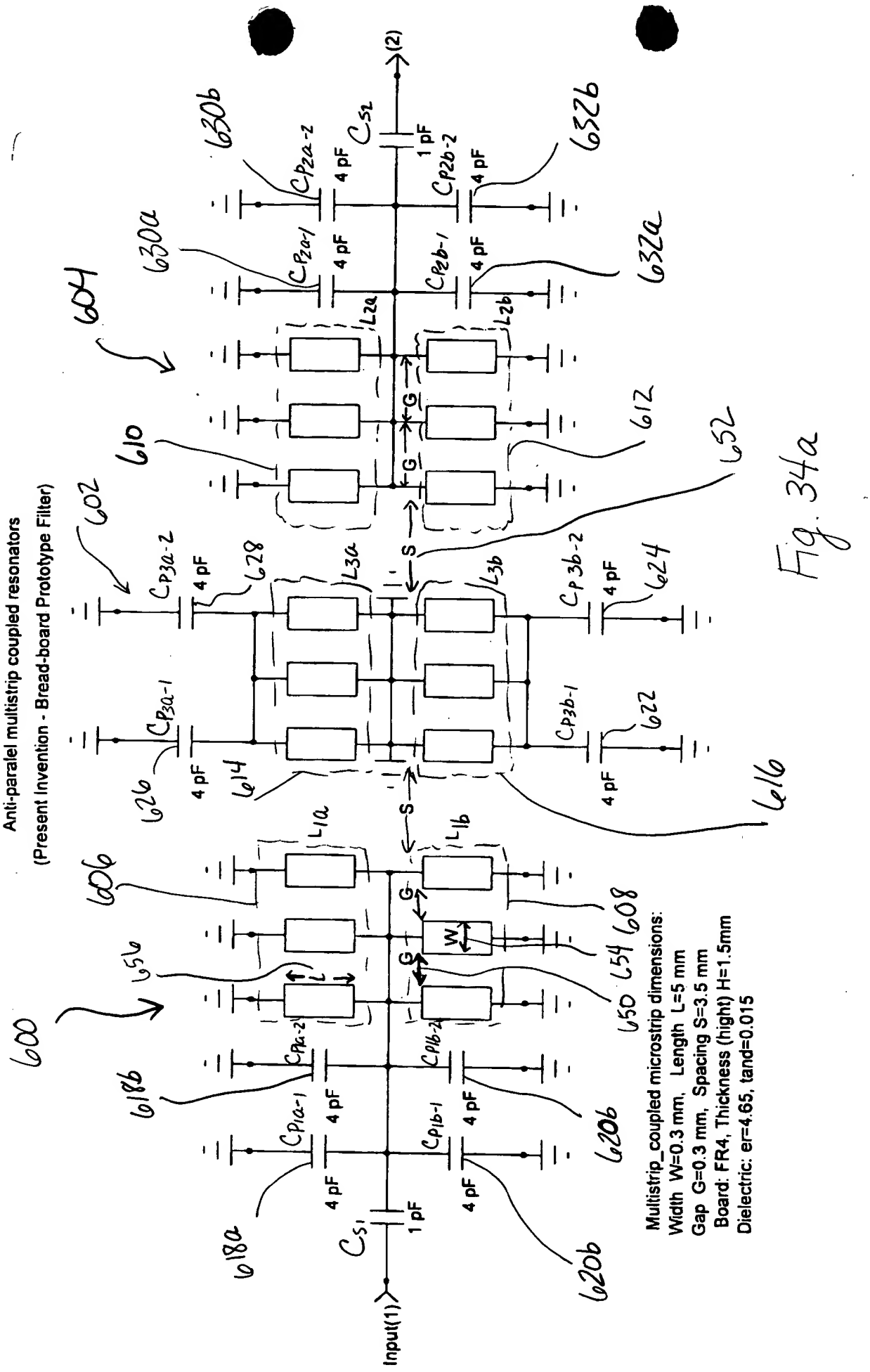

Band Pass Filter: fc= 1015.75 MHz, BW = 30 MHz
Anti-paralel multistrip coupled resonators
(Present Invention - Bread-board Prototype Filter)
600
602
604
606
608
610
612
614
616
618a
618b
620a
620b
622
624
626
628
630a
630b
632a
632b
650
652
654
Input(1)
(2)
C_{S1}
C_{S2}
C_{P1a-1}
C_{P1a-2}
C_{P1b-1}
C_{P1b-2}
C_{P2a-1}
C_{P2a-2}
C_{P2b-1}
C_{P2b-2}
C_{P3a-1}
C_{P3a-2}
C_{P3b-1}
C_{P3b-2}
L_{1a}
L_{1b}
L_{2a}
L_{2b}
L_{3a}
L_{3b}
1 pF
4 pF
S
G
W
L
Multistrip_coupled microstrip dimensions:
Width W=0.3 mm, Length L=5 mm
Gap G=0.3 mm, Spacing S=3.5 mm
Board: FR4, Thickness (hight) H=1.5mm
Dielectric: er=4.65, tand=0.015

Fig. 34a

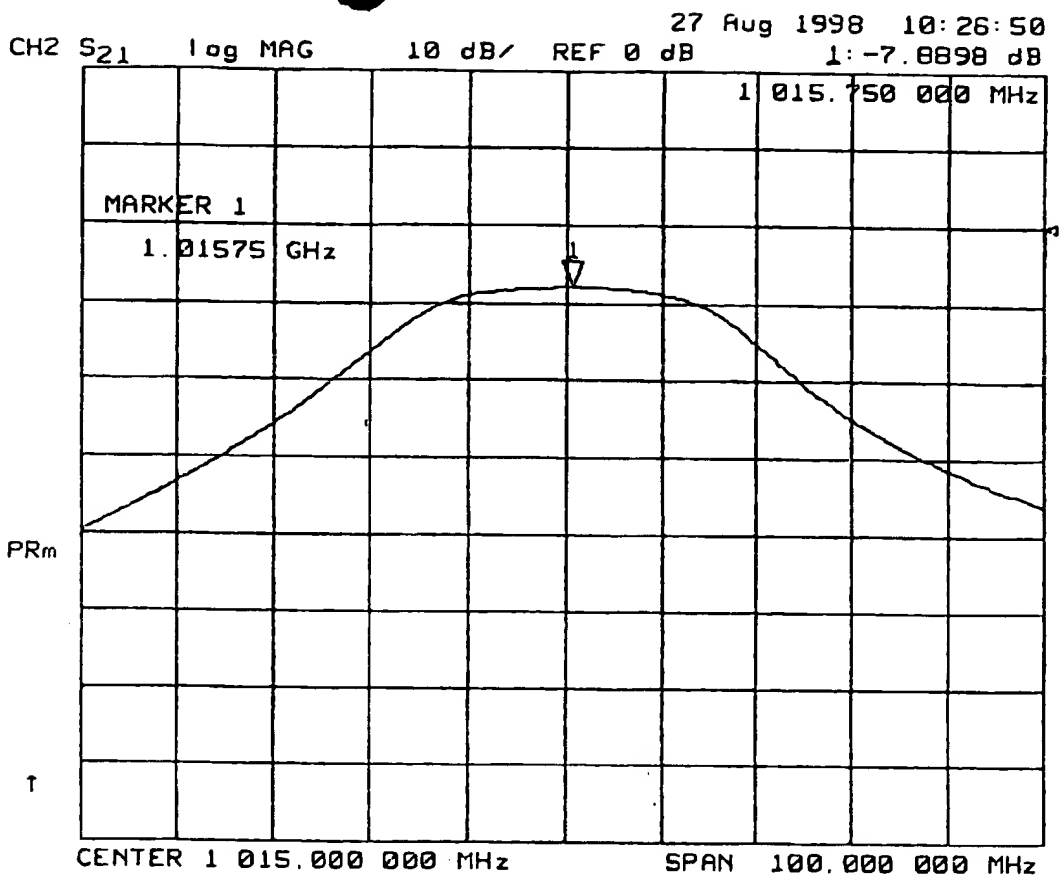

27 Aug 1998 10:26:50
CH2 S21 log MAG 10 dB/ REF 0 dB 1:-7.8898 dB
1 015.750 000 MHz
MARKER 1
1.01575 GHz
PRm
CENTER 1 015.000 000 MHz
SPAN 100.000 000 MHz

Fig. 346

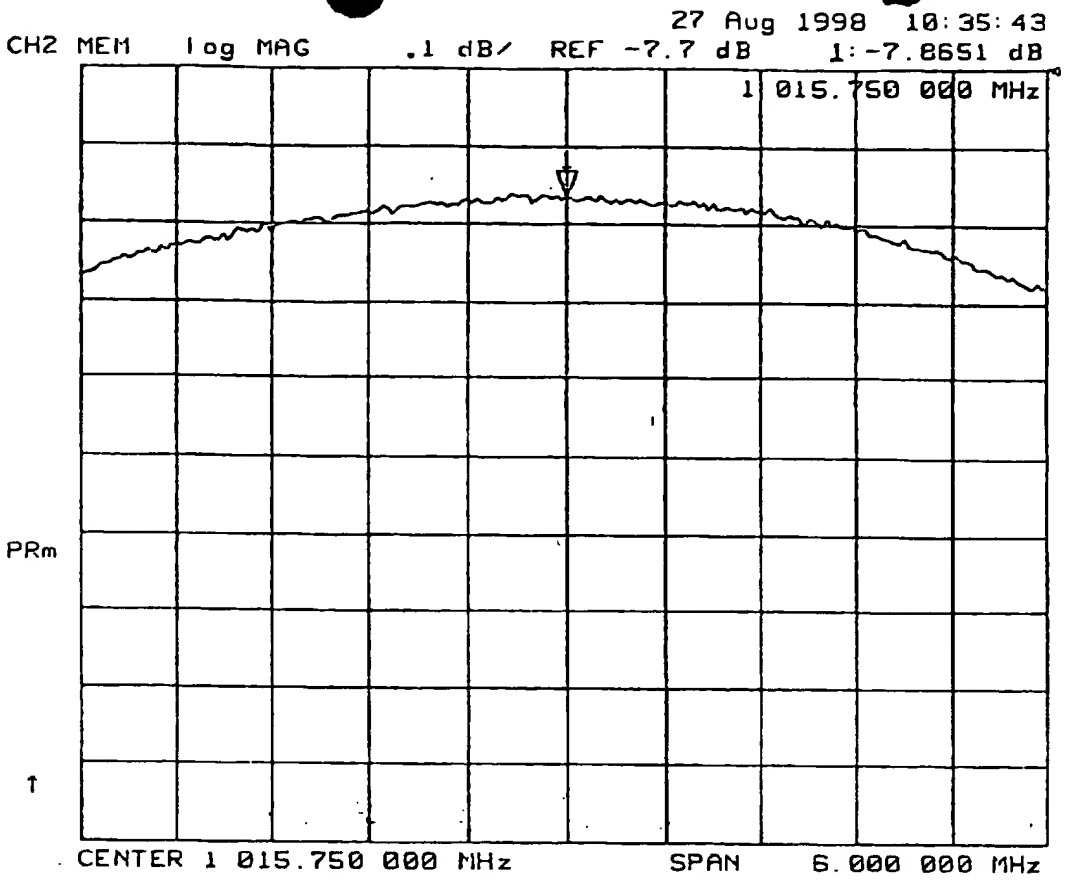

27 Aug 1998 10:35:43
CH2 MEM log MAG .1 dB/ REF -7.7 dB
1:-7.8651 dB
1 015.750 000 MHz
PRm
CENTER 1 015.750 000 MHz
SPAN 6.000 000 MHz

Fig. 34C

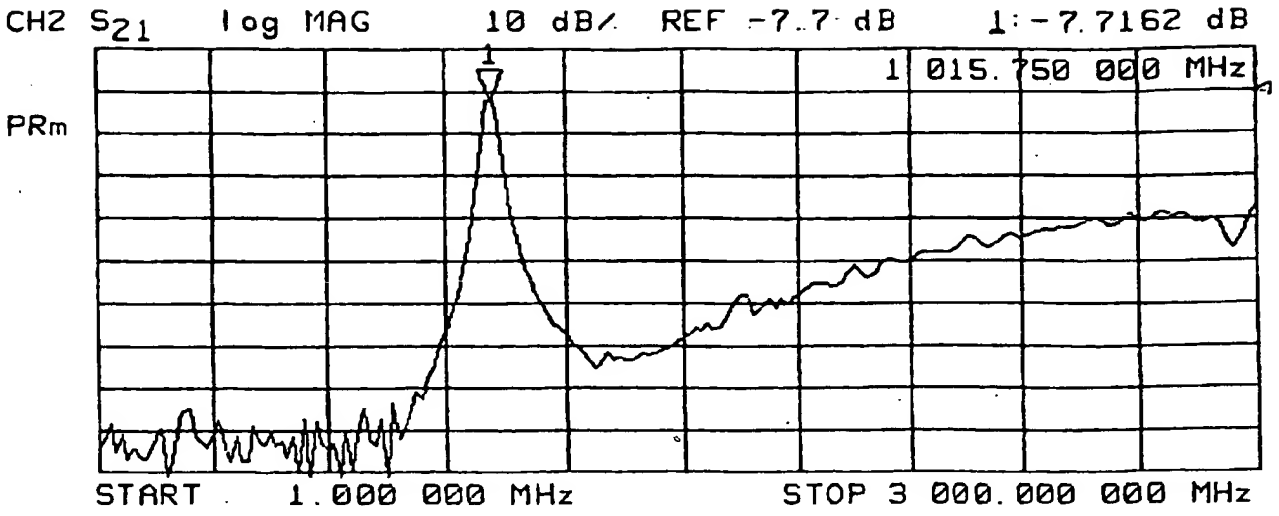

CH2 S21 log MAG 10 dB/ REF -7.7 dB 1:-7.7162 dB
1 015.750 000 MHz
PRm
START 1.000 000 MHz
STOP 3 000.000 000 MHz

Fig. 34d

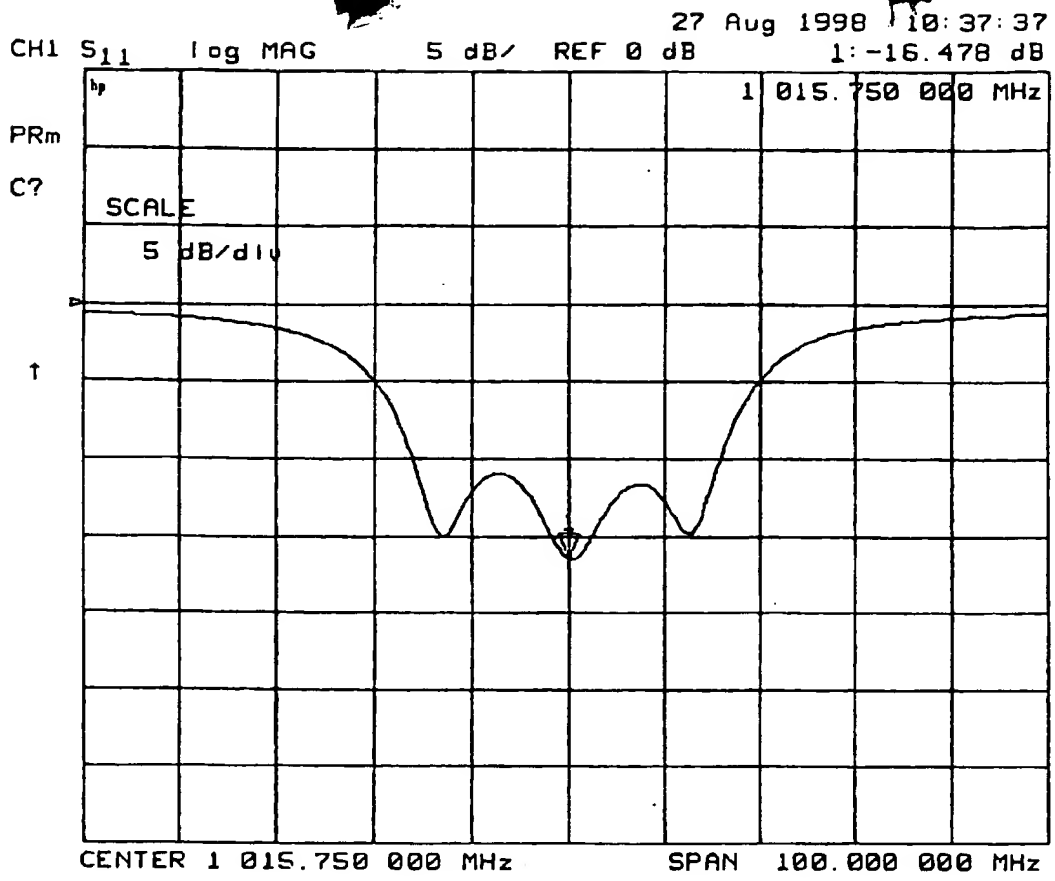

27 Aug 1998 10:37:37
CH1 S11 log MAG 5 dB/ REF 0 dB 1:-16.478 dB
hp
1 015.750 000 MHz
PRm
C?
SCALE
5 dB/div
CENTER 1 015.750 000 MHz
SPAN 100.000 000 MHz

Fig. 34e